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The German Financial Market

An Empirical Investigation into the Natural Stackelberg Situation and Initial Public Offering

By

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Abstract

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There are five chapters in this thesis. Chapter one is an introduction. Chapters two, three, and four are self-contained essays and Chapter five concludes.

The purpose of chapter two is to examine empirically, which kind of competition serves the German Financial Market best. Results from unique time series data sets suggest four important findings: First, trades offered in the stock exchanges under investigation can be seen as differentiated goods. Second, playing a sequential game is most beneficial for all stock exchanges in Germany. Third, given the facts, the degree of information revelation is greater in the case of the Frankfurt Stock Exchange, and fourth, own effects dominate cross effects. We conclude that participants in the German Financial Market should play a Stackelberg asymmetrical game, as this is more beneficial for all players, instead of playing Nash.

Chapter three examines the listing decision of German initial public offerings (IPOs), i.e., should an IPO go public in the 1st or the Neuer Markt Segment. Using cross sectional data of the German financial market we find the following: First, smaller and riskier firms list in a dealer market. Second, younger firms are more likely to list in a dealer market. Third, IPO listings weakly cluster by industry, i.e., software and technology firms are more likely to list on the Neuer Markt segment than other firms. Fourth, follow-on strategies and other included qualitative variables do not play an important part in the listing decision of German IPOs, and fifth, the German dealer market was created not as a competitor for the auction market but to provide market maker sponsorship. We conclude that younger and riskier firms should join the Neuer Markt Segment, as they will gain from the market maker sponsorship.

In chapter four, the different cost components IPOs are faced with are investigated. We find that: First, in the dealer market benefits are higher than costs for young and small IPOs. Second, there exists no real competition in the considered segments, and third, well known IPOs will be guided straight into the auction market, the 1st market segment. I contribute again by defining variables that describe the German Financial Market in analysing financial statements, balance sheets, profit and loss accounts, etc., constructing unique data sets, which were non-existing so far. Different variables to the ones used in Chapter three are the different Cost Components, Underwriter Market Share, Venture Backed Capital, and dummies called 1st Segment and NM (Neuer Markt).

Chapter five concludes, gives an overview of further research to be done and recommends a certain strategy to company policy makers.

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Preface

Most of this work took place in my home office as I was registered as a part-time student from the very beginning of my research studies. The University of Southampton supported this research by giving me the opportunity of being enrolled as a part-time research degree student.

Chapter three was presented as a self-contained research paper at the University of Southampton's compulsory PhD research paper seminar. I am grateful for participants of this seminar for their interest and helpful comments. Moreover, chapter three has been published in the "International Journal of Theoretical and Applied Finance (IJTAF), Vol.6, No. 2, (2003) 1-25".

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I would like to thank my wife Gabriele for her patience and moral support, and my children Saskia and Sinja who never understood that I was away so often from any family activities. The importance of family support is tremendous for the completion of a thesis.

I also owe a great debt to several peer students, two anonymous referees for their constructive criticism as well as to the University of Southampton for giving me the opportunity of studying part-time.

The motivation for the three papers that this thesis mainly consists of arose from a series of conversations with Dr Antonella Ianni who gave her time to offer advice on the economic theory parts of the papers and for her constructive remarks.

The helpful comments of Dr Jan Podivinsky, who encouraged me during my time as a PhD student to go on in my studies, always took the time to discuss the particular problems I had as a part-time student, is gratefully acknowledged. His suggestions improved my thesis considerably.

Nevertheless, any errors are my own responsibility and remain, as ever and forever, on my conscience alone.

Abbreviations

AG	:	Aktiengesellschaft = Share Holder Company
AMEX	:	American Stock Exchange
ANOVA	:	Analysis of Variance
ANCOVA	:	Analysis of Co-variance
BLUE	:	Best Linear Unbiased Estimator
bn	:	billion
C, c	:	Costs
CHSQ	:	Chi Square
Coef.	:	Coefficient
Cov.	:	Co-variance
DIL	:	Dual International Listings
DS	:	Designated Sponsors
e.g.	:	exempli gratia, which stands for "for instance"
ed.	:	edition
eds.	:	editors
EEC	:	European Economic Community
Et al.	:	et alii: and others
Etc.	:	et cetera = and so forth
EU	:	European Union
FAQ	:	frequently asked questions
FSE	:	Frankfurt Stock Exchange (floor and XETRA)
GOB	:	Grundsaetze ordnungsgemaesser Buchfuehrung German GAAP
HGB	:	Handelsgesetzbuch = German Trade Code
i.e.	:	id est, that is
IAS	:	International Accounting Standard
iid	:	independently and individually distributed
Inc.	:	Incorporation
INPT	:	Intercept
IO	:	Industrial Organisation
IPO(s)	:	Initial Public Offering(s)
LSE	:	London School of Economics
MTB	:	Market-to-Book
n.a.	:	not available
Nasdaq:	:	National Association of Securities Dealers Automated Quotations
NM	:	New Market Segment (Neuer Markt = equivalent of NASDAQ)
no.	:	Number
NSS	:	Natural Stackelberg Situation
NYSE	:	New York Stock Exchange
OLS	:	Ordinary Least Squares
Op. cit.	:	opere citato = in the volume quoted
OTC	:	over the counter
p	:	price
p., pp.	:	page, pages
q	:	quantity
PRF	:	Population Regression Function
RF	:	Reaction Function

RSEs	:	Regional Stock Exchanges
S.E.	:	Standard error
Subscript F	:	Stackelberg Follower
Subscript i	:	Frankfurt Stock Exchange (floor and XETRA)
Subscript j	:	Regional Stock Exchanges
Subscript L	:	Stackelberg Leader
Subscript N	:	Nash equilibrium
TIC	:	Total Issue Costs
UK	:	United Kingdom
UP	:	Underpricing
US	:	United States (of America)
UWS	:	Underwriter-Spread
V	:	Cost Variance (Degree of Information Revelation)
Var	:	Variance
VBC	:	venture backed capital
VC	:	venture capital
Viz.	:	videlicet (videre licet): namely
Vol.	:	volume
Xetra	:	Exchange Electronic Trading

Chapter one: Introduction

The introduction of the Neuer Markt segment in Germany on March 1997 by the Frankfurt Stock Exchange, the main stock exchange in terms of volume of trades and turnover, was a major milestone in the evolution of the German Financial Market. It was modelled on Nasdaq. The intention was to take the German financial market away from the banking based funds raising system, comparable to the Japanese system, to a stock exchange based funds raising system as in the United States of America and similar systems (see Born [2001]).

The launch of the Neuer Markt segment had two main purposes: firstly, to give young and growth oriented companies the opportunity to raise money via the stock exchange, and, secondly, to attract more investors from an international environment to take more German securities in their portfolio by making the companies more visible to them in issuing accounts and statements not only according to GOB (Grundsaetze Ordnungsgemaesser Buchfuehrung = German Accounting Principles) and the German Trade Code (Handelsgesetzbuch), but also consistent with IAS (International Accounting Standards) and US-GAAP (United States-Generally Accepted Accounting Principles) issued in the English language. This thesis consists of three self contained essays and contributes by analysing different aspects of the German Financial Market using existing theoretical models and estimating them by raw data received from the Frankfurt Stock Exchange and the IPOs directly. For each chapter of the self contained essays a comprehensive literature survey has been conducted. In this thesis I present what I believe is the first comprehensive empirical investigation of economic mechanisms of quantity competition and the behaviour of firms going public in Germany. This has involved a detailed analysis of data available and collation of financial documents such as balance sheets, profit & loss accounts, annual statements, etc.

Chapter two is using the model of quantity competition developed by Heinrich von Stackelberg (1934), published in his famous book "Marktform und Gleichgewicht" and extended by Albaek (1990), describing a so-called NSS (Natural Stackelberg

Situation) taking costs into consideration and discussing extensively the prerequisites for an NSS to exist, such as stochastic technology, costs of the players being uncorrelated, and defining the properties of the costs . He works out a scenario, where the choice structure is sequential (the so-called Stackelberg equilibrium) but even more profitable to all participants in the market than when the choice structure is simultaneous (the so-called Nash-equilibrium). Defining the market leader and follower strategy, thus formulating a duopoly, which simply is an oligopoly with only two players in the market, this model can be used for the German Financial market. There, 9 different stock exchanges exist, but the main stock exchange is the Frankfurt Stock exchange, which exceeds the remaining stock exchanges in terms of trades, turnover, available instruments, and different market facilities by far. All remaining regional stock exchanges' data is accumulated and they are treated as one player in the market. Albaek distinguishes between a certainty and an uncertainty model. In this chapter only the uncertainty model is of interest due to the empirical nature of the investigation. He defines then 6 different situations in his model and what the outcome is, i.e., NSS, Nash, or a Monopolistic situation. Furthermore, he provides an explanation why an NSS in a pure price strategy space cannot exist.

The model is then estimated by monthly data received from the Frankfurt Stock exchange. In order to make the behaviour of the coefficients over time visible I use a recursive regression equation estimated by OLS (Ordinary Least Squares) and draw first conclusions from the graphs received. Then using static and dynamic models and estimating them by OLS I investigate the parameters of the Frankfurt Stock Exchange and then the Regional Stock Exchanges. The "General-to-Specific" approach is used to investigate whether the omission of some variables make the model more stable, I start with an ARDL (Autoregressive-Distributed-Lag) model, using then a DL (Distributed-Lag) model, and finally a pure AR (Autoregressive) model.

The findings of this study are, firstly, trading at different stock exchanges can be seen as differentiated goods. The second finding is that playing a sequential game is most beneficial to the participants of the German Financial Market, which was confirmed by the econometric analysis. Third, given the facts, the degree of information revelation of the FSE (Frankfurt Stock Exchange) is much greater than the one of the RSEs (Regional Stock Exchanges), and, fourth, own effects dominate cross effects. This chapter of the thesis is trying to fill the huge existing gap between IO (industrial organization) theory and the securities industry, which has found only little attention so far and attempts to drive this literature forward.

The first contribution of this chapter is the analysis of a time series data set from January 1998 to December 2002 and the construction of so-called "proxies" representing prices which are not available straight away, and the second contribution is that it is the first study of this kind, where the mentioned model of sequential decisions of IO theory is applied to German data sets and according to my knowledge has not been applied to any other data sets of any economy so far. Finally, I contribute in this chapter by measuring the degree of differentiation, viz., I find that own effects dominate cross effects in both examined cases of the Frankfurt Stock Exchange and the Regional Stock Exchanges which is in accordance with economic theory.

In Chapter three the listing decision of IPOs (Initial Public Offerings) is examined. Again, I use an existing model developed by Aggarwal and Angel (1997) where trade-off between listing fees and market quantity as well as expected de-listing costs are taken into consideration. They argue that the best market place for a firm to raise capital is a function of the spreads in the different segments, the relative visibility, and the firm's idiosyncratic risk, size, and overall investor risk aversion. This model has already been estimated by Corwin and Harris (2001) for the US market using a Probit model, where the dependent variable is qualitative in nature, while explanatory variables are either quantitative or qualitative, in order to take properties of the US-market into consideration.

I use a dichotomous Probit model as well and estimate it for the German market with available cross-sectional data for the period of March 1997 to December 2001. Explanatory qualitative variables are different for the German market than for the US-market. For example, reverse LBOs (the listing firm has previously traded on one of the exchanges) and carveouts (the listing firm has an exchange listed parent firm) do hardly exist in the German Financial market. Thus, I contribute by using unique data sets that have not been used for an investigation of the listing decision of IPOs in the German Financial Market so far by constructing a quantitative variable, the Market-to-Book variable, which is the market value of equity plus the book value of debt divided by total assets, another quantitative variable is firm age, which is the number of years of incorporation to the public going event, and defining a qualitative variable which describes a specific kind of IPOs in Germany in an appropriate way, viz., dual international listings, i.e., the IPO is already listed on an international stock exchange. Another qualitative variables are technology firm and industry dummy variable. Moreover, I develop a rating of designated sponsors table similar to the one developed by Carter and Manaster (1990) for the US-Market which is needed for the investigation of the data, in particular in Panel A of Table 3.3 of chapter three, and which is unique so far in the literature of the listing decision of German IPOs.

Then, I contribute further by working out differences and similarities between the US market and the German market place and draw conclusions about the listing decision of German IPOs and give an explanation for these differences. I find the following: Firstly, smaller and riskier firms list on Neuer Markt, which is consistent with the expected de-listing hypothesis of Foucault and Parlour (2001). Secondly, younger firms are more likely to list on Neuer Markt Segment which provides support for the sponsorship hypothesis developed by Aggarwal and Angel (1997), thirdly, IPO listings weakly cluster by industry, which is consistent with the finding of Corwin and Harris (2001), fourthly, follow-on strategies and international dual listings do not appear to play an important role in the listing decision of IPOs in Germany, and finally, Neuer Markt was created to provide a market maker sponsorship segment and not as competitive segment. I contribute to the existing literature by providing a detailed analysis of the listing decision of German IPOs and the interpretation and conclusion of this analysis. Also here exists a huge gap in the existing literature which is filled by this chapter.

Chapter four represents an event time study of the costs of going public and answers the question whether IPOs should take costs into consideration or whether they should list on the market segment which provides more support for their capital raising intention but might be more expensive. Using the model developed by Foucault and Parlour (2001) where stock exchanges compete for IPO listings, and which was as well estimated for the US market by Corwin and Harris (2001).

I estimate the model for the German market place using an ANCOVA (Analysis of Co-variance) model, where explanatory variables are either quantitative or qualitative in nature, estimated by OLS and conducting an analysis for all cost components available, i.e., Underwriter-Spread, Underpricing, and Total Issue Costs. Unfortunately, data on Other Expenses such as listing fees, fees for auditors, Road shows and other expenses to make the IPO known are not available. Listing fees have been calculated as a percentage of the market value from the fee tables in appendix 1 and the results of the regression analysis are also shown in the appendix but no further investigation has been conducted due to the deterministic nature of the data, i.e., as the listing fees are simply a proportion of the market value, empirical evidence show a high degree of non-normality of disturbances, a miss-specified model, and heteroscedasticity.

I contribute by using unique data sets, that have not been used in any research so far according to my knowledge, defining "German" qualitative variables to describe characteristics of the German Financial market and which differ from the qualitative variables used by Corwin and Harris (2001) in their investigation of the US-market, such as dual international listings and venture backed capital, where the portion of backing capital in the German market is 17 %, while in the US-market it is 25 %. The 17 % level is due to the fact that most companies in Germany that hold equities of IPOs, hold 17 % of them in most cases. Hence, using this level means giving the qualitative variable venture backed capital more importance. This makes this qualitative variable rather unique. Moreover, I construct other quantitative variables, such as Market Value, which was also used in Chapter three, by multiplying outstanding shares by offer price, as the Market Value published by the Frankfurt Stock Exchange does contain values of follow-on strategies, thus receiving another unique data set, and Underwriter Market Share, which is the proportion of all IPO proceeds for which a particular underwriter served as market maker.

Starting the investigation using only data from IPOs fulfilling requirements for both market segments I find that it is not statistically significant whether an IPO is listed on the auction market or the dealer market, i.e., the 1st market segment or the Neuer Markt segment. I then include all IPOs available, thus taking an additional market segment, the so called SMAX into consideration, which is a further contribution of this thesis and which differs much from the investigation of the US-Market. Hence, an additional qualitative variable NM is included.

Using a cross-sectional data set for the period of March 1997 to December 2001 I cover the whole period with the outstanding rise of the Nemax (Neuer Markt Index) up to more than 8,000 points and the downfall of it to less than 600 points, in particular after the attacks of September 11th, 2001 against the United States of America and its impact to the economic cycle of the whole world. Again, I work out differences and similarities between the US and the German Market. Evidence from cross-sectional data suggests that a German IPO will be guided into the Neuer Markt segment due to the designated sponsorship, which acts as a liquidity support unless its size and knowledge of existence to the public is sufficient to enter the auction market directly. I contribute to the existing literature by providing a detailed analysis of the costs of going public and its impact in the choice of an appropriate market segment. Also here exists a huge gap in the literature, in particular in the German environment, and this chapter fills it.

Chapter five provides some concluding remarks and summarises. Further suggestions for research arise directly from the issues discussed but also from latest research in the United States of America. It concludes by giving some firm policy advice.

In summary, this thesis extends the existing literature of applied studies, in particular in Germany and captures a detailed analysis in a comprehensive way. As far as I am aware, this is the first study where theoretical models of the international finance literature are estimated empirically by recent data sets of the German financial market, thus filling a gap in the existing literature, but leaving enough room for further research in the field of the application of IO-theory to and empirical investigation of the securities industry.

Chapter two: Quantity Competition in the German Securities Industry

2.1 Introduction

In this paper the German financial stock market will be analysed and the question is answered whether the market participants[1], hereinafter simply referred to as players[2], should either play a sequential game, the so-called Stackelberg asymmetrical equilibrium, or whether they should decide simultaneously, i.e., they should prefer the Nash equilibrium. Moves in a game may be regarded as the selection of a quantity strategy, i.e, the whole investigation is conducted in the so-called Cournot strategy space.

The basic underlying of this paper is Heinrich von Stackelberg's famous book "Marktform und Gleichgewicht" which was published in 1934. He analysed the problems of monopolistic competition and based the whole theoretical discussion on a simple duopoly[3]. He distinguished 9 different types of markets, each one characterised by one type of supply condition and the same or a different type of demand condition (see annexe 1). Stackelberg pointed out that in a homogenous market a price differentiation is impossible due to the fact, that if one seller demands a higher price for a perfect substitute than her competitor the consumer will immediately move to her competitor. Stackelberg described the behaviour of the two sellers in two ways, firstly, the behaviour of seller 1 does not influence the behaviour of seller 2, and, secondly, a seller responds immediately to the moves of her competitor. If seller 2 assumes that her competitor acts independently and she adjusts her output decisions accordingly, then she accepts the role of a follower. If seller 1 assumes that seller 2 behaves like a follower, she accepts the role of a leader.

[1] Participants are: "All enterprises admitted to trading on the Frankfurt Stock Exchange", Rules for the Determination of Exchange Prices in Floor Trading on the Frankfurt Stock Exchange, June 1, 1999. The same is valid for the Regional Stock Exchanges.

[2] In this paper we will avoid to use exclusively masculine pronouns to show our awareness that there are ‚shes‘ as well as ‚hes‘. We do that in using „she“ when using personal pronouns. It is hoped that no reader of this paper finds this convention confusing or aesthetically unpleasing.

[3] The author called it „dyopoly“ but here the term „duopoly“ is used as it has prevailed in the recent years.

Following this discussion Stackelberg defined three possible situations: Firstly, seller 1 and seller 2 assume that the other one behaves like a leader, and, thus, behave themselves as followers, secondly, both assume the other one to be the follower and behave as leaders, or, finally, one acts as a follower expecting the other one to be the leader.

The first case is the solution described by Cournot, while the second case leads to the solution described by Bowley[4], where both players try to obtain the leadership, hence a Nash equilibrium prevails. Case three finally results in an "asymmetrical equilibrium" where the behaviour of seller 1 corresponds to the expectations of seller 2 and vice versa. Situation three is what is known as a Stackelberg equilibrium.

This paper is organised that in section 1.1 a comprehensive literature review is given. Section 2 introduces the theoretical model and its assumptions, and examines cost uncertainty. Then, in section 3 the econometric analysis is conducted, and results are interpreted. Section 4 summarises and concludes.

2.1.1 Literature Review

The question arises why one player should accept market leadership of the other one instead of trying to achieve market leadership herself. Economic literature shows that in the case of cost uncertainty and prohibition of information sharing duopolists can commit themselves to be either a Stackelberg leader or a follower instead of playing Nash.

Gal-Or (1985) analysed the reaction functions of the players in a sequential game and came to the conclusion that if these reaction functions of the players slope upwards (downwards) in a quantity space, the player that moves first (Stackelberg

[4] Stackelberg referred to the book of Bowley, A.L., 1924, Mathematical Groundwork of Economics, Oxford, S. 38. However, he pointed out that according to his opinion Bowley has derived his conclusions from the famous paper of Edgeworth, 1925, "The Pure Theory of Monopoly", Papers Relating to Political Economy, London, Vol. 1, pp. 111 ff. Moreover, Stackelberg claimed that the basic work of "Bowley's Duopoly" was developed by Moore, Henry L., 1905/06, "Paradoxes of Competition", Quarterly Journal of Economics, Vol. 20, pp. 211 ff.

leader) will gain lower (higher) profits than the player reacting to this move (Stackelberg follower) (see also Dowrick [1986]).

Albaek (1990) defined in his paper the so-called NSS (Natural Stackelberg Situation) where the choice structure is sequential. An NSS in the quantity space exists where one firm prefers to be the leader and the other one accepts to be the follower instead of playing leader or Nash. In a price strategy space an NSS cannot exist.

Kim (1987) investigated the case of finding an optimal price-quality schedule under imperfect information. As prices are the strategic variables firms always decide simultaneously. Boyer and Moreaux (1987) continue this discussion and came to a surprising conclusion. Whatever the role of the player (leader, follower or Nash competitor), it is always more profitable to be a quantity (price) setter if the goods are substitutes (complements). Moreover, they define a price Stackelberg situation which ranks higher than a quantity Stackelberg situation. However, they concluded that whatever the goods are, substitutes or complements, there is no strategic context which uniformly meets consumers' and producers' interests.

Ross (1986) developed a theory which favours the so-called learning curve as another reason for a Stackelberg equilibrium. His main argument was that a firm introducing a new product will realise efficiency through experience in production, and called it learning by doing. He described a learning curve and the adjustment process through which unit costs are decreased and approach the minimum attainable. The key feature of his paper is that tomorrow's cost depend on today's production. Thus, this slight lead down the learning curve allows a firm to dominate the market. A later entrant has to go through the same learning process and cannot reach the leader if the managers of the dominant company choose a strategy where production is a function of the market environment, the decision of competitors and future opportunities.

Kim (1987) argued that firms can provide different qualities for one type of product. If a market is characterised by heterogeneous consumers, firms will find it optimal to offer different qualities of one product for different prices. Brander and Eaton (1984) argued that most firms do not just offer one product but a complete product line. In their view interactions between associated strategic effects and demands for different products are the key determinants of the product line of a single company. The basic message of this paper is that it is important for the understanding of product line rivalry to recognise the sequential nature of decision making.

Grinblatt and Ross (1985) investigated the case of a Stackelberg leader in the securities market and the importance of access to information. They distinct two information structures, one in which all agents have identical information and one where the agents have independent, or asymmetrical information. They show how market power and information structure interact to distort competitiveness.

However, if information sharing is prohibited the question is raised what the second best solution for the industry could be. In a market with homogenous products, quantity competition and symmetric costs, both firms prefer to be the leader which leads to a Nash outcome (see also Osborne and Rubinstein [1997]). Albaek (1990) showed that if cost uncertainty is introduced firms prefer the Stackelberg situation to the Nash outcome if their cost variance (see Fried [1984], Sakai [1985] and Li [1985]) is sufficiently different. Recent literature shows that an informed firm will always prefer to be the Stackelberg leader despite the fact that the follower realises then that demand is high (Boyer and Moreaux [1987a, 1987b]).

Van Damme and Hurkens (1998) investigated a linear quantity setting game and which of the players will commit when both players could do so. They study a two stage game and come to the conclusion that committing is more risky for the high cost firm and that only low cost firms will choose to commit. They called it an "action commitment game".

It can be summarised that an NSS can only exist where one firm is unsure about the cost structure of the other firm. According to EU competition law and also according to United States authorities[5] it is prohibited to exchange information which shows the behaviour of one individual firm or the behaviour of individual firms can be deduced. Cini and McGowan (1998, p. 17) showed that the EU-Commission is opposed to information sharing policy in that the EEC treaty "... prohibits agreements or

[5] See EEC Treaty on European Union Article 85 [81] and the February 15, 1935 issue of the Bulletin of the American Institute of Accountants, where the institute feared that the disclosure of sales, cost of sales and gross profit may be harmful to the competitive position of some companies.

concerted practices between firms which are likely to prevent, restrict or distort trade within the Community".

This paper contributes by estimating a purely theoretical model and its assumptions empirically with unique data series, that have not been used for such a kind of investigation. Hence, we calibrate the theoretical model to German conditions and circumstances. In other words, applied research is conducted in order to predict the most efficient strategic behaviour of the players. We will show that the German Financial Market serves its players best if the decision is made sequentially.

The difference of cost variance of the two players is also discussed. We conclude that the Frankfurt Stock Exchange must have the greater cost variance as their cost structure is much more complex. Then, the degree of uncertainty, i.e., the coefficient of substitution, γ, in the observed period (January 1998 to December 2002) is determined. We come to the conclusion that predictions derived from the long-run equations of the two demand functions are much more reliable than the ones obtained from the short-run equations.

2.2 The Model

The following model for which a system of two linear inverse demand functions is assumed will be used for the investigation of the German Financial Market (see Albaek [1990], Sakai [1986], Gal-Or[1985], Singh and Vives [1984]). The reason why a model with two demand functions has been chosen is that trades at the Stock Exchanges under consideration are assumed to be differentiated goods as there are stocks traded at the Regional Stock Exchanges which are not traded at the Frankfurt Stock Exchange and vice versa. Moreover, different trading technologies are associated with different trading costs, which is due to different trading mechanisms such as auction or dealer market (see Foucault and Parlour [2001], Madhavan [1992] and Bessembinder [1999], table 2.8 and section 3.2.3.

Demand Functions:

$p_1 = \alpha - \beta q_1 - \gamma q_2$

$p_2 = \alpha - \gamma q_1 - \beta q_2$

Where $\alpha > 0$, $\beta > |\gamma| \geq 0$. The offered goods are either substitutes, independent or complements, depending on $\gamma > 0$, $\gamma = 0$, and $\gamma < 0$ respectively. Moreover, $\beta^2 > \gamma^2$ is the usual requirement that own effects dominate cross-effects.

For the ease of the investigation it is assumed that there are no fixed costs, but linear and random costs, $C_i(q_i) = c_i q_i$, where $i = 1,2$, representing the 2 players of the duopoly and they are faced by stochastic technology[6]. Moreover, the costs of the two firms 1 and 2 are uncorrelated, $Cov(c_1, c_2) = 0$, having the properties $E(c_i) = 0$, and $Var(c_i) \equiv V_i \geq 0$ (see also Albaek, 1990, p. 338), where V_i represents the degree of information revelation, and takes a finite value, $0 < V_i < \infty$ (to be further discussed in section 2.1). The deviation of actual marginal cost from expected marginal cost $\hat{c}_i$, c_i are bounded in such a way that the strategies will not result in non-positive prices, i.e., $\hat{c}_i + c_i < 0$ should not be possible. Moreover, the strategies depend linearly on costs.

The complete model is given in Albaek (1990) and the exercise is not repeated here. We report the conclusions he derives.

Lemma 1. The unique Bayesian - Nash equilibrium is subject to:

$q_i^*(c_i) = (\alpha/(2\beta+\gamma)) - (1/2\beta)c_i$ a.s. for $i = 1,2$

with the resulting ex ante expected profits

$J_{Ni} = (\alpha^2\beta/(2\beta+\gamma)^2) + (1/4\beta)V_i \qquad i = 1,2$

Moreover, Albaek (1990) calculates the ex ante expected profits for two further situations, firstly, when costs are random but common knowledge:

$J_{Ni} = [\alpha^2\beta/(2\beta+\gamma)^2] + [4\beta^3/(4\beta^2 - \gamma^2)^2]V_i + [\beta\gamma^2/(4\beta^2 - \gamma^2)^2]V_j$

Secondly, an intermediate case is when i knows the cost of j, but not vice versa:

$$J_{Ni} = [\alpha^2\beta/(2\beta+\gamma)^2] + [1/(4\beta)]V_i + [\beta\gamma^2/(4\beta^2 - \gamma^2)^2]V_j$$
$$J_{Nj} = [\alpha^2\beta/(2\beta+\gamma)^2] + [4\beta^3/(4\beta^2 - \gamma^2)^2]V_j$$

Since $4\beta^3/(4\beta^2 - \gamma^2)^2 > 1/4\beta$ it is preferable to share information about cost, which is in accordance with the result of Gal-Or (1986) who finds that cost sharing is a dominating strategy under Cournot competition.

Lemma 2. The unique Stackelberg equilibrium is subject to:

$$q_F^* (c_F, q_L) = (\alpha - \gamma q_L - c_F)/2\beta \text{ a.s.}$$
$$q_L^* (c_L) = [\alpha(2\beta - \gamma)/(2(2\beta^2 - \gamma^2))] - (\beta/(2\beta^2 - \gamma^2))c_L \text{ a.s.}$$

with the resulting ex ante expected profits:

$$J_F = [\alpha^2(4\beta^2 - 2\beta\gamma - \gamma^2)^2/16\beta(2\beta^2 - \gamma^2)^2] + \beta\gamma^2/4(2\beta^2 - \gamma^2)^2]V_L + [1/(4\beta)]V_F$$
$$J_L = [(\alpha^2(2\beta - \gamma)^2)/(8\beta(2\beta^2 - \gamma^2))] + [\beta/(2(2\beta^2 - \gamma^2))]V_L$$

The calculations above result in the following ranking:

Lemma 3. For player i the conditions determining the evaluation of the ex-ante expected profit in the leader, the follower and the Nash positions are:

(i) $J_{Li} > J_{Ni} \Leftrightarrow \alpha^2\gamma^2 > - 2(2\beta + \gamma)^2V_i$

(ii) $J_{Ni} > J_{Fi} \Leftrightarrow \alpha^2\gamma(16\beta^3 - 8\beta\gamma^2 - \gamma^3) > 4\beta^2(2\beta + \gamma)^2V_j$

(iii) $J_{Li} > J_{Fi} \Leftrightarrow \alpha^2\gamma(4\beta - 3\gamma) > 4\beta^2(V_j - V_i) + 4(\gamma^2 - \beta^2)V_i$

[6] Gal-Or (1986) defined stochastic technology if the cost variance is a finite positive number, $0 < \sigma_c < \infty$, i.e., the cost variance can never approach infinity which is due to the fact that at least common information is available to all market participants.

2.2.1 Cost Uncertainty

When cost uncertainty is introduced, the degree of substitutability, γ, and cost variance, V_i, where i = 1,2, enter into the model. In the following, a decision table has been derived from the observations of Albaek (1990, p. 341 - 3) for an uncertainty model.

Table 2.1: Summarised Observations of the Uncertainty Model

If:	**Company (i)**	**Company (j)**	**Outcome***
$\alpha^2\gamma^2 > -2(2\beta + \gamma)^2 V_i$	Stackelberg Leader	Stackelberg Leader	Nash
$\gamma = 0$	Monopolistic Situation	-	Monopolistic Situation
$\beta = \gamma$ (perfect substitutes) if $V_i > 1_j$	Stackelberg Leader > Nash	Stackelberg Follower > Nash	NSS
$\beta = -\gamma$ (perfect complements) if $V_i > V_j$	Stackelberg Leader > Nash	Stackelberg Follower > Nash	NSS
$\gamma < 0$	Stackelberg Follower > Nash	Stackelberg Follower > Nash	Nash
$\gamma > 0$ if $V_j > V_i$	Stackelberg Follower > Nash	Stackelberg Leader > Nash	NSS

* The higher the smallest cost variance the more difficult becomes the existence of an NSS

In examining the degree of information revelation, annual reports of the 9 different stock exchanges have been used and investigated. On the average, annual reports were available for the years from 1997 to 2001. It has been approved by auditors, that the accounting and annual financial statements are in accordance with professional standards and comply with German legal provisions as well as accepted accounting principles. Thus, annual financial statements give true and fair views, with respect to German professional standards, of assets, liabilities, financial positions and income of the respective stock exchanges. Especially the Profit and Loss Accounts reveal the annual costs of the firms in that personnel expenses, depreciation[7], other

[7] Normally, tangible fixed assets (such as building or machine, etc.) are depreciated on a straight line basis over the period of their estimated useful lives [d(t) = (K - S)/N, where K = capital, S = scrap and N number of years used]. Another method extensively used in Germany is the so-called "degressive" method, also called double-declining balance method, where a certain percentage of the depreciated remaining value or book value of the asset can be written off [d(t) = 2B(t)/N, where B(1) = K, B(t+1) is the previous year's value, B(t) minus that year's depreciation, d(t)]. However, when the depreciation values get smaller than the straight line method values, one has to change from "degressive" to the straight line method. However, these methods give no true picture of the real value of the tangible fixed

operating expenses, such as particular expenses for computer services and organisational consultancy etc. and taxes of income.

As this information is published and available to everybody, it is of no advantage to any one firm. However, it can be concluded that the Deutsche Boerse AG which runs its own research department is in the position of having more information available than Regional Stock Exchanges. Moreover, the cost structure of the FSE makes it more difficult to infer cost structures from this institution for the German Regional Stock Exchanges. Hence, less cost information is being revealed by the Frankfurt Stock Exchanges than by the others. It must also be taken into consideration that the Stock Exchanges may try to "cheat" within the legal framework in order to send some wrong signals of information to their competitors.

For real cost determination a so-called "Internal-Balance Sheet Accounting" or "Management Accounting" is conducted but never published. This type of balance sheet accounting presents as complete a picture as possible of costs to the managers of the company and is made in a way the managers themselves think it is appropriate. The information available from the published balance sheet accounting following the Standard Accounting Principles in Germany has to be taken with a grain of salt, as it still represents a distortion of a company's true financial position in terms of "real costs". This is underlined by an article in 'The Economist' of March 3, 1990, where it is stated that "... traditional accounting methods lose relevance when applied to manufacturing systems which are flexible and re-usable".

But even worse, the fact that only very few German companies are listed on the World's largest capital market, the NYSE (New York Stock Exchange), is that German Accounting Principles do not aim to give analysts or investors a 'true' or merely 'fair' picture of the company's financial condition. The main obstacle is that German companies do not comply with the "US-Generally Accepted Accounting Principles" (US GAAP) (see Born [2001]). The 'Financial Times' of March 19, 1992 published an article where an analyst showed "... how the Volkswagen car company's 1989 profits would grow from DM 1.04bn under German rules, to DM 1.5bn under UK rules and DM 1.9bn under US rules". In a recent article in the 'Frankfurter Allgemeine Zeitung' of

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assets, and, thus, no real picture about costs, e.g., after the useful live of three years, computer-facilities

May 09, 2001, the leading economic newspaper in Germany, it was shown that if the assets are evaluated according to IAS (International Accounting Standard), the ratio of own capital to borrowed capital rises from 13.3 % as per Generally Accepted German Accounting Principles to 21.9 % as per IAS.

2.3 Regression Analysis

The above model is estimated for monthly data received from the Information Centre of the Frankfurt Stock Exchange (Deutsche Boerse AG) from January 1998 to December 2002. As a first working hypothesis, we assume that the non-stochastic PRF (population regression function) $E(P \mid Q_1, Q_2)$ is a linear function of Q_1, Q_2, technically expressed as:

$$E(P^F_i \mid Q_{1i}, Q_{2i}) = \alpha + \beta Q^F_i + \gamma Q^R_i$$
$$E(P^R_j \mid Q_{1j}, Q_{2j}) = \alpha + \gamma Q^F_j + \beta Q^R_j$$

Where the dependent variables of the simultaneous equation system are:

P^F	Price of the FSE[8] (Frankfurt Stock Exchange including XETRA[9])
P^R	Price of the RSEs[10] (Regional Stock Exchanges)

the regressors are:

Q^F	Number of trades at FSE

are much more worth than the "reminder value" of one EURO. (see Shy [1998]).

[8] "The Frankfurt Stock Exchange consists of two trading platforms, namely the floor and Xetra (Exchange Electronic Trading), the electronic platform (see down-below). Of Course, the floor trading is supported through an electronic exchange order routing system, called BOSSE-CUBE, which ensures that orders are directly transmitted. "Floor trading Customer buy and sell orders are brought to exchange by banks and financial services firms. Orders are either specified precisely - with a limit on the price range - or are unlimited, in which case the transaction is conducted at the best price available. All buy and sell orders are entered in the order ledgers of the official brokers (Kursmakler)". See FWB The Frankfurter Wertpapierboerse, published by: Deutsch Boerse AG, 60284 Frankfurt/Main, June 1998, Order-Number: 1010-0691

[9] "Xetra,, the fully computerised cash market trading system of Deutsche Boerse AG, enables trading in equities, equity warrants (company-issued) and bonds on a single platform - anywhere within the European Union and Switzerland". See Xetra® Release 3 - Leading Edge, p. 4, published by Deutsche Boerse AG, 60284 Frankfurt/Main, January 1999, Order Number: 2110-0809

[10] RSEs are in Stuttgart, Hamburg, Duesseldorf, Munich, Cologne, Bremen, Hanover and Berlin.

Q^R	Number of trades at RSEs

2.3.1 Data Characteristics and Sample Properties

We start the investigation by testing the data for unit roots and spurious regression. As can be seen in annexe 4, P^F, P^R, Q^F, and Q^R represent a random walk. Next, we use the ADF (Augmented Dickey-Fuller unit root test see Pesaran and Pesaran [1997]) with trend test, based on the equation:

$$\Delta Y_i = \alpha + \rho\delta t - \rho Y_{i-1} + \Sigma\, \gamma_j \Delta Y_{i-j} + u_i$$

where Y represents P^F, P^R, Q^F, Q^R, $i = 1, \ldots n$, and $j = 1, \ldots k$ (where ADF statistic up to the 12^{th} order was checked, k= 12, motivated by the fact that we have monthly data[11]; for results see annexe 4). The null-hypothesis is $H_0 : \rho = 1 - \phi = 0$, data is non-stationary or I(1), and the alternative hypothesis is $H_1 : \phi < 1$, data sets are trend stationary, I(0).

Table 2.2: Tests for Unit Roots and Co-integration

2.2.1 Panel A: Unit Roots Tests for Variables

	P^F	P^R	Q^F	Q^R
N	60	60	60	60
Standard-linear	-2.2160	-2.9192	-2.0602	-2.4404
Log.-linear	-2.2167	-2.6563	-1.8478	-2.6099
Δ*	-9.1457	-6.2287	-9.7272	-7.0631
Δ(Log)*	-8.0478	-6.3170	-9.2497	-7.0373
95 % Critical Value	-3.5066	-3.5066	3.5066	-3.5189
95 % Δ Critical Value	-3.5088	-3.5088	-3.5088	-3.5088
H_0 rejected	N/N/Y/Y	N/N/Y/Y	N/N/Y/Y	N/N/Y/Y

* data series is differenced once

It is obvious, that for all standard linear and log.-linear variables the null hypothesis of unit roots cannot be rejected. The first differenced data series do not

[11] The Akaike Information Criterion and the Schwarz Bayesian Criterion suggest different lengths of k for the different variables. For the sake of completion, the complete results are shown in annexe 4.

exhibit a unit root, i.e., the original data series is integrated of order 1, I(1). However, in examining models with more lags we do not reject the null-hypotheses of unit roots (see annexe 4).

If, however, there exists a stationary linear combination of non-stationary variables, the variables combined are said to be co-integrated. In other words, we test if there is a long run relationship between the variables (i.e., the data series cannot move to far away from each other).

Hence, we test for unit roots of the residuals based on the equations:

$$u_i = P^F_i - \alpha - \beta Q^F_i - \gamma Q^R_i$$
$$u_j = P^R_j - \alpha - \gamma Q^F_j - \beta Q^R_j$$

H_0: the series is non-stationary, while H_1: this is not true. If we find that u_i and u_j are stationary, then the variables P^F_i, Q^F_i, Q^R_i, P^R_j, Q^F_j, and Q^R_j are co-integrated, i.e., a linear combination of the variables of the equations is stationary.

2.2.2 Panel B: Unit Roots Tests for Residuals*

Based on OLS regression of mentioned regressands on: INPT Q^F Q^R

	Specification 1 P^F	Specification 2 P^R	Specification 3 P^F	Specification 4 P^R
Estimation Method	**OLS Stand.-linear**	**OLS Stand.-linear**	**OLS Log-linear**	**OLS Log-linear**
DF	-3.4814	-4.3972	-4.2503	-4.3069
ADF(1)	-2.7198	-2.6373	-3.1237	-2.9276
ADF(2)	-2.3540	-2.2568	-3.6275	-3.1559
ADF(3)	-2.2945	-2.6196	-3.6935	-3.4461
ADF(4)	-2.2815	-2.6314	-3.1854	-3.0512
95 % Critical Value	-2.2679	-2.2679	-2.2679	-2.2679

*** 60 observations have been used for all specifications; The Akaike Information Criterion and the Schwarz Bayesian Criterion suggest lags of k = 4 for the different variables.**

In all specifications, the null-hypothesis of no co-integration is rejected. Hence, the residuals are co-integrated, saying that there is a long term relationship between the variables. In this case, OLS estimators are said to be super consistent, because they converge to the "true value" at a much faster rate than with conventional asymptotics (see Verbeek [2000]).

2.3.2 The Econometric Regression Model

A standard linear OLS regression analysis will be conducted firstly, and then, secondly, upon re-specifying a log-linear form will be used.

Unfortunately, optimal data is not available and "Proxies" must be used for estimating the theoretical economic model of section 2. "Prices" are in fact values per trade. But this reflects as well the price consumers are prepared to pay for the securities and the transactions. Hence, the "price" consists of Bank charges, broker's fees and the price of the securities themselves, which depends, of course, on the law of demand and supply, and, as a matter of fact, can fluctuate enormously. Nevertheless, the price per trade, which is interesting for the purpose of this paper, is a fixed percentage of the value of the trade, i.e., the transactions of buying and selling the securities (for a detailed list of prices charged by the Frankfurt Stock Exchange and by Official Exchange Brokers see appendices 5 and 6).

It is assumed and subsequently tested that the usual assumptions of classical linear regression analysis are not violated and that there is no simultaneous equation bias.

The static stochastic PRFs (population regression functions) are technically expressed as:

$$P^F_i = \alpha + \beta Q^F_i + \gamma Q^R_i + u_i$$

$$P^R_j = \alpha + \gamma Q^F_j + \beta Q^R_j + u_j$$

Next, we use the Hendry approach of model selection (see Hendry and Richard [1982]). Starting with the most general model we whittle down to more specific models.

The ARDL (autoregressive-distributed-lag) short-run (partial adjustment) models with a finite lag of m respectively n time periods are:

$$P^F_i = \delta\alpha + \delta(\beta_0 Q^F_i + \beta_1 Q^F_{i-1} + \ldots + \beta_m Q^F_{i-m}) + \delta(\gamma_0 Q^R_i + \gamma_1 Q^R_{i-1} + \ldots + \gamma_m Q^R_{i-m}) + (1 - \delta)(P^F_{i-1} + \ldots + P^F_{i-m}) + \delta u_i$$

$$P^R_j = \delta\alpha + \delta(\gamma_0 Q^F_j + \gamma_1 Q^F_{j-1} + \ldots + \gamma_n Q^F_{j-n}) + \delta(\beta_0 Q^R_j + \beta_1 Q^R_{j-1} + \ldots + \beta_n Q^R_{j-n}) + (1 - \delta)(P^R_{j-1} + \ldots + P^R_{j-n}) + \delta u_j$$

Where short run coefficients are found by using the ad-hoc estimation procedure for the lagged dependent variables (see Alt [1942]), $\delta\Sigma\beta_i$ and $\delta\Sigma\gamma_i$ where $i = 1, \ldots n$, and m respectively. After having received the values of the dynamic models, the long-run coefficients will be calculated by dividing each of the short-run estimates by the estimate of the adjustment coefficient, δ, where $0 < \delta \leq 1$.

If $\delta = 0$; the dependent variable does not adjust,
if $\delta = 1$; the dependent variable adjusts instantaneously.

The resulting long-run price functions are :

$$P^{F*}_i = \alpha + \beta_0 Q^{F*}_i + \gamma_0 Q^{R*}_i + u_i$$

$$P^{R*}_j = \alpha + \gamma_0 Q^{F*}_j + \beta_0 Q^{R*}_j + u_j$$

Where P^{F*}_i or P^{R*}_j is the desired price, or long run dependent variable, and $Q^{F*}_{i,j}$ and $Q^{R*}_{i,j}$ are the expected levels of output, lagged regressands are simply omitted (see Smith [1996]).

The DL (distributed lag) models with a finite lag of m respectively n time periods are:

$$P^F_i = \alpha + \beta_0 Q^F_i + \beta_1 Q^F_{i-1} + \ldots + \beta_n Q^F_{i-n} + \gamma_0 Q^R_i + \gamma_1 Q^R_{i-1} + \ldots + \gamma_m Q^R_{i-m} + u_i$$

$$P^R_j = \alpha + \gamma_0 Q^F_j + \gamma_1 Q^F_{j-1} + \ldots + \gamma_n Q^F_{j-n} + \beta_0 Q^R_j + \beta_1 Q^R_{j-1} + \ldots + \beta_m Q^R_{j-m} + u_j$$

The AR (autoregressive) models are:

$$P^F_i = \delta\alpha + \delta\beta_1 Q^F_i + \delta\gamma_1 Q^R_i + (1 - \delta)(P^F_{i-1} + \ldots + P^F_{i-m}) + \delta u_i$$

$$P^R_j = \delta\alpha + \delta\gamma_1 Q^F_j + \delta\beta_1 Q^R_j + (1 - \delta)(P^R_{j-1} + \ldots + P^R_{j-n}) + \delta u_j$$

For the calculation of the short- and long-run coefficients of the AR and DL models see ARDL models above.

2.3.2.1 Testing the Simultaneous Equation System

Using OLS to estimate the parameters β and γ of the demand function can result in "simultaneous equation bias", i.e., the parameters have biased and inconsistent estimators unless the model is recursive.

A recursive model has the characteristic that the endogenous variable of the first equation is only determined by exogenous variables (see Gujarati 1995, pp. 680 - 682). It is assumed that in the first equation of the stochastic model given above Q^F_i and Q^R_i are exogenous while P^F_i is endogenous. The question must be answered whether Q^F_i is un-correlated with u_j. Q^F_i which is affected by u_i is by assumption uncorrelated with u_j. Therefore, P^F_i is predetermined, at least insofar as P^R_j is concerned. Thus, OLS can be applied to the first equation.

In the second equation the endogenous variable is P^R_j and Q^F_j and Q^R_j are again exogenous. It can be concluded that there is no interdependence between Q^F_i and P^R_j as each one is the result of its turnover which is divided by the respective number of trades, Q^F and Q^R, which are exogenous. Hence, OLS can also be applied to the second equation.

Hausman (1978) pointed out that in a simultaneous equation system, which is estimated equation by equation, the researcher neglects the so-called "internal consistency" of the entire specification made. Thus, an important potential resource of information on model mis-specification has not been taken into consideration. Hence, we test for the simultaneity problem the following way:

1. Regressing P^F_i on Q^F_i and Q^R_i, we obtain and save u_i
2. Next, we regress P^R_j on P^F_i and u_i. Then a t-test on the saved residuals is performed. Being significant, the null-hypothesis of simultaneity is not rejected; otherwise it is.

Table 2.3: Results of Specification Consistency ("Hausman Specification Test")

Regressand **Regressors**	**Spec. 1** P^R	**Spec. 2** P^R
Functional Form	OLS (Stand.-Linear)	OLS (Log-Linear)
N	60	60
INPT	15891.7 (.000)	8.2294 (.000)
P^F	.070394 (.069)	.14890 (.038)
u_i	.13303 (.139)	.69434 (.056)

In specification 1, the p-value of .139 shows us that the t-test of u_i is statistically not significant. Hence, there is no evidence of a simultaneity problem and the result given above, that there is a recursive model has been confirmed. To double-check even these results, the log-linear model in specification 2 has been used to verify the results given above. The p-value of .056 confirms that u_i is marginally insignificant. There is no simultaneity problem.

2.3.2.2 Are the Coefficients significantly different from each other?

Next we test whether the coefficients are significantly different from each other, in order to check if the trades at the Stock Exchanges can be seen as differentiated goods. Hence, we want to test the null-hypothesis

$H_0 : \beta = \gamma$ or $(\beta - \gamma) = 0$ against the alternative hypothesis

$H_1 : \beta \neq \gamma$ or $(\beta - \gamma) \neq 0$

i.e., the two slope coefficients are equal.

Table 2.4: Results of the Tests for Equality of the two Coefficients

	Spec. 1 FSE	**Spec. 2 FSE**	**Spec. 3 RSEs**	**Spec. 4 RSEs**
	Stand.-linear	Log.-linear	Stand.-linear	Log.-linear
N	60	60	16	60
β	-.0042185	-.91801	-.0077560	-.42963
γ	.0045288	.42344	-.0023485	-.35011
Var(β)	.7769E-7	.0012472	.1475E-5	.28446E-3
Var(γ)	.5657E-6	.0015860	.2243E-5	.22370E-3
Cov(β,γ)	-.1691E-7	.1369E-3	-.1422E-5	.2505E-4
Observed t-value	-27.80	-26.5158	-2.5119	-3.8892
$t_{\alpha/2}$, $\alpha = 10$ %	2.353	2.353	2.353	2.353
$t_{\alpha/2}$, $\alpha = 5$ %	3.182	3.182	3.182	3.182
$t_{\alpha/2}$, $\alpha = 1$ %	5.841	5.841	5.841	5.841
$\lvert t \rvert > t_{\alpha/2}$ = **reject H_0**	Y/Y/Y	Y/Y/Y	Y/N/N	Y/Y/N

Results are as expected. In specification 1 and 2, the trades of the two competitors can be seen as differentiated products. In specification 3 the null-hypothesis cannot be rejected at the 5 % and 1 % level, while in specification 4 it cannot be rejected at the 1 % level, saying, that shares traded at the RSEs are still differentiated, but not at such high levels as the ones of the FSE.

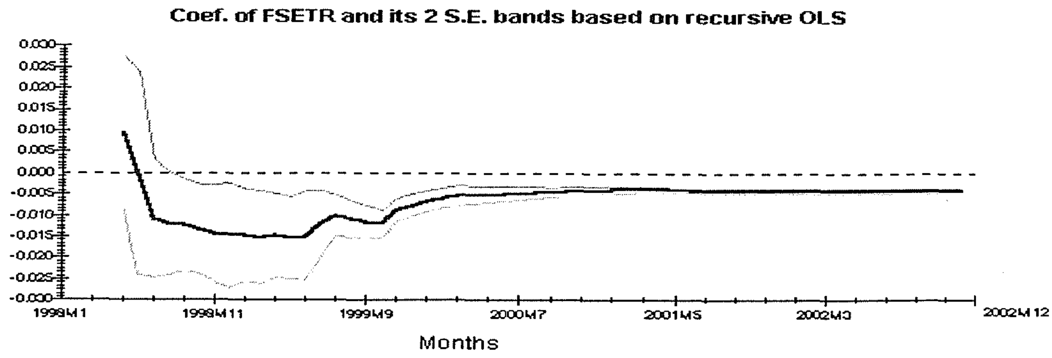
2.3.3 Results and Interpretation

In the following, the results of the regression analysis for the FSE and the RSEs are shown and interpreted. The behaviour of the parameter γ is of great interest for the purpose of this paper as exactly this behaviour needs to be observed to infer whether the FSE should try to be the Stackelberg leader, the follower, or even play Nash in order to maximise profit.

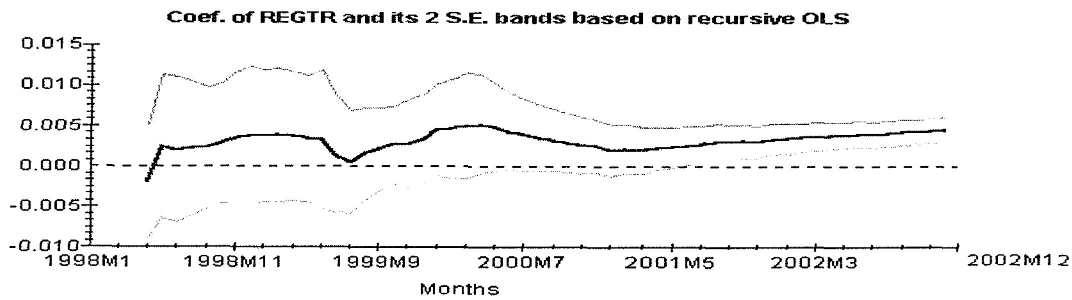
Next, the graphs of the recursive regression equation are estimated by OLS:

Demand function i:

The behaviour of β_i is shown:

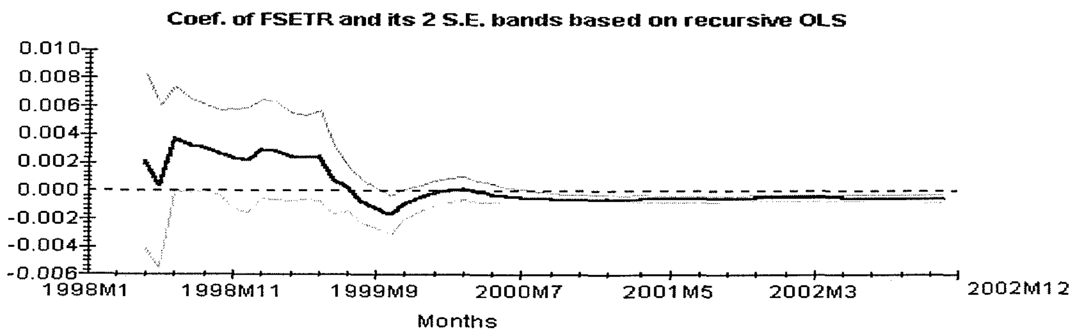


next, the behaviour of γ_i is shown:

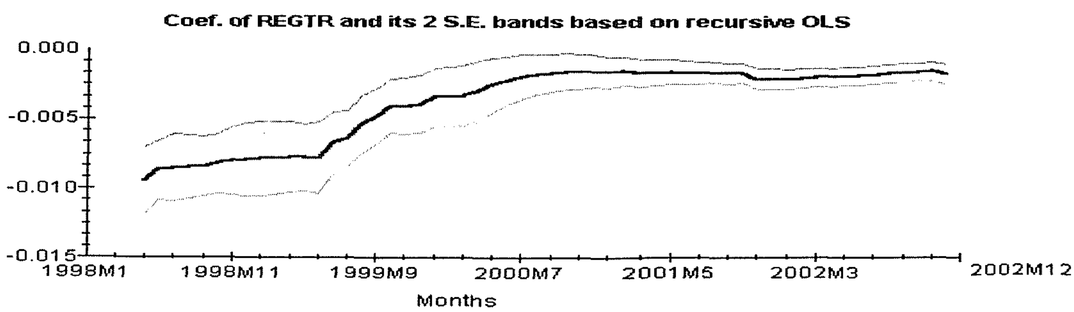


Demand function j:

The behaviour of γ_j:



Finally, the behaviour of β_j is:



The graphs of the behaviour of the coefficients for the case of log-linear regression models are shown in annexe 3.

If the price of the FSE is the dependent variable, γ starts to be negative but then turns to be positive after a very short period, for all investigated cases, i.e., for OLS in absolute values as well as relative values (see section 3.2 and annexe 2). This means that if the RSEs increase their number of trades, the price of the FSE goes up. Knowing that the "price" is in fact the value per trade, the best solution for the RSEs is not to increase the number of trades subject to their own profit maximisation, as consumers will immediately move to the FSE. If the number of trades at FSE increases the prices charged by the FSE decreases. This is in accordance with the theory of economies of scale and what one expects.

In investigating the RSEs we find that the coefficient γ is positive for less than half of the investigated period and between August and September 1999 turns to be negative, then being for several months zero it turns to be negative again. That means that both players prefer to be Stackelberg Leader to playing Nash for the first half of the investigated period. If both players try to obtain a Stackelberg Leadership, the Nash outcome will prevail. Then, γ turns to be negative. Now, if the FSE increases her number of trades, the price of the RSEs decrease. If the RSEs increase their number of trades, their own price will decrease either. This is the main difference to the FSE. The FSE dominates the market in such a way, that an increase of trades of the RSEs is harmful to their (RSEs-) profit striving behaviour which is also the case if the FSE increases their number of trades. Thus, it is better for the RSEs to take the output of the FSE as given and not trying to increase their own output.

2.3.3.1 The Frankfurt Stock Exchange

Table 2.5: Results of OLS for the FSE[⊗]

P^F → Regressors ↓	Spec. 1 (static)	Spec. 2 (static)	Spec. 3 (ARDL)*	Spec. 4 (DL)*	Spec. 5 (AR)*
N	**60**	**60**	**59, 1 lost**	**59, 1 lost**	**59, 1 lost**
Estimation Method	OLS (Stand.-linear)	OLS (Log.-linear)	OLS (Log.-linear)	OLS (Log.-linear)	OLS (Log.-Linear)
INPT	67987.1 {4391.5} [15.4814] (.000)	18.8018 {.86883} [21.6528] (.000)	8.2883 {2.2625} [3.6633] (.001)	18.9067 {.90552} [20.8794] (.000)	8.4150 {1.8772} [4.4828] (.000)
Q^F	-.0045288 {.2787E-3} [-15.1347] (.000)	-.91801 {.035316} [-25.9941] (.000)	-.40019 {.13174} [-3.0378] (.004)	-.64659 {.14652} [-4.4130] (.000)	-.39664 {.092923} [-4.2684] (.000)
Q^R	.0041185 {.7521E-3} [6.0213] (.000)	.42344 {.039825} [10.6325] (.000)	.16194 {.11457} [1.4135] (.163)	.34238 {.13044} [2.6248] (.011)	.16527 {.057059} [2.8964] (.005)
$P^F(-1)$	-	-	.56953 {.11441} [4.9781] (.000)	-	.56397 {.099353} [5.6764] (.000)
$Q^F(-1)$	-	-	.0089366 {.13962} [.065271] (.948)	-.26592 {.15037} [-1.7685] (.083)	-
$Q^R(-1)$	-	-	.0021386 {.10650} [.020081] (.984)	.067607 {.12684} [.53300] (.596)	-
R^2	.81569	.93730	.96140	.94335	.96139
R-bar-squared	.80922	.93509	.95775	.93915	.95928
F-Statistic	2, 57 (.000)	2, 57 (.000)	5, 53 (.000)	4, 54 (.000)	3, 55 (.000)
Durbin's h-statistic	-	-	(.385)	-	(.594)
Diagnostic Tests**					
Serial Correlation	(.012)	(.085)	(.070)	(.011)	(.084)
Functional Form	(.013)	(.056)	(.295)	(.017)	(.299)
Normality	(.051)	(.722)	(.911)	(.823)	(.901)
Heteroscedasticity	(.013)	(.949)	(.345)	(.683)	(.350)
Predictive Failure	CHSQ [4] (.305)	CHSQ [4] (.113)	CHSQ [7] (.312)	CHSQ [6] (.529)	CSHQ [5] (.235)
Chow Test of Parameter Stability	CHSQ [3] (.177)	CHSQ [3] (.111)	CSHQ [6] (.209)	CSHQ [5] (.346)	CHSQ [4] (.141)

Values in brackets are {standard errors}, [t-values], and (p-values)

[⊗] Specification 3 to 5 represents the LSE approach, or the general to specific approach

* ARDL = autoregressive-distributed lag, DL = distributed lag and AR = autoregressive model

** From the diagnostic tests only the p-values will be reported

Table 2.5 provides the results from different specifications of the OLS-model for which 60 observations have been used through all specifications. Diagnostic tests for all 5 specifications are acceptable and no null hypothesis must be rejected. The null-hypothesis of all coefficients being equal to zero (joint-hypothesis = F-test) can be rejected at the zero per-cent levels, even if Q^R, $Q^F(-1)$ and $Q^R(-1)$ in specification 3 and $Q^F(-1)$ and $Q^R(-1)$ in specification 4 appear not to be statistically significant. The 'goodness of fit', R^2 is at reasonable high levels through all specifications, ranging from 82 % to 96 %, and all predictive failure and parameter stability tests are statistically insignificant, saying that the null hypothesis of adequate predictions and stability of parameters through all specifications must not be rejected. Durbin's h-statistic in specifications 3 and 5 are both highly statistically insignificant, suggesting that the null hypothesis of no first order auto-correlation is not rejected.

In specification 1, if the number of trades at the FSE goes up by 1 trade, the price per trade at the FSE decreases by .45 EURO-cents, all other things being equal. An increase of 1 trade at the RSEs leads to a rise in price at the FSE of .41 EURO-cents, ceteris paribus.

In specification 2, a 1 % increase in the FSE number of trades results in a 0.92 % FSE price decrease per trade, ceteris paribus. This means, unit elasticity is approached. A 1 % increase in the number of trades of the RSEs results in a 0.42 % increase of the FSE per trade price, other things constant, i.e., if the RSEs increase their prices, investors see no necessity of moving from FSE to the RSEs.

Specification 3 shows the results of an ARDL (autoregressive-distributed-lagged) model. The estimate of the adjustment coefficient, δ, is (1 - .56953) = 0.43047. That is that the long run impact is 43 %, meaning that 43 % of the discrepancy between the desired and the actual price is eliminated in a year. Thus, the long-run function is given below:

$$.P_i^{F*} = (8.2883/.43047) + (-.39125/.43047)Q_i^{F*} + (.16409/.43047)Q_i^{R*}$$

$$= 19.25 - 0.91Q_i^{F*} + 0.38Q_i^{R*}$$

Increasing the number of trades at the FSE by 1 % decreases the FSE price per trade in Euro by .91 %, other things being the same, being almost unit elasticity. Increasing the number of trades at the RSEs by 1 % leads to a Euro price rice of .38 % at the FSE, ceteris paribus.

The DL (distributed lag) model in specification 4 gives:

$$P_i^{F*} = 18.91 - 0.91Q_i^{F*} + 0.43Qi^{R*}$$

In the long-run, a 1 % increase in the number of trades at FSE results in a 0.91 % decrease in the FSE-price per trade, ceteris paribus. A 1 % increase in the number of trades at the RSEs leads to a rise of the FSE-price per trade of 0.43 %, other things unchanged.

As a next step, the results of the AR (autoregressive) model are displayed in specification 5. The estimate of the adjustment coefficient, δ, is (1 - .56397) = 0.43603. That is that the long run impact is 43.6 %, i.e., 43.6 % of the discrepancy between the desired and the actual price is eliminated in a year. Thus, the long-run function is given below:

$$P_i^{F*} = (8.4150/.43603) + (-.39664/.43603)Q_i^{F*} + (.16527/.43603)Q_i^{R*}$$

$$= 19.29 - 0.91Q_i^{F*} + 0.38Q_i^{R*}$$

In the long run, an increase of 1 % in the quantity of trades of the FSE leads to a decrease of 0.91 % of the price per trade at the FSE, other things being equal. An increase of 1 % of the quantity of trades at the RSEs leads to an increase of 0.38 % of the price of the FSE, ceteris paribus.

By including more lagged variables into the dynamic models, we have to reject the null-hypothesis of normally distributed disturbances. Hence, no further investigation will be conducted.

2.3.3.2 The Regional Stock Exchanges

Table 2.6: Results of OLS for the RSEs[⊗]

P^R → Regressors ↓	Spec. 1 (static)	Spec. 2 (static)	Spec. 3 (ARDL)*	Spec. 4 (DL)*	Spec. 5 (AR)*
N	**16**	**60**	**59, 1 lost**	**59, 1 lost**	**59, 1 lost**
Estimation Method	OLS (Stand.-linear)	OLS (Log.-linear)	OLS (Log.-linear)	OLS (Log.-linear)	OLS (Log.-Linear)
INPT	46939.7 {4553.4} [10.3078] (.000)	21.9117 {1.1629} [18.8422] (.000)	9.1534 {2.3480} [3.8983] (.000)	22.1202 {1.1282} [19.6063] (.000)	15.3557 {2.4560} [6.2353] (.000)
Q^F	.0023485 {.0014977} [1.5921] (.135)	-.35011 {.047297} [-7.4042] (.000)	.63450 {.15248} [4.1611] (.000)	.31273 {.18256} [1.7131] (.092)	-.21873 {.059929} [-3.6498] (.001)
Q^R	-.0077560 {.0012147} [-6.3853] (.000)	-.42963 {.053335} [-8.0553] (.000)	-1.1638 {.13234} [-8.7944] (.000)	-.94112 {.16252} [-5.7908] (.000)	-.32760 {.059035} [-5.492] (.000)
$P^R(-1)$	-	-	.62005 {.10407} [5.9581] (.000)	-	.29585 {.10978} [2.6949] (.009)
$Q^F(-1)$	-	-	-.78102 {.14744} [-5.2973] (.000)	-.67433 {.18735} [-3.5993] (.001)	-
$Q^R(-1)$	-	-	.95857 {.14473} [6.6231] (.000)	.50845 {.15804} [3.2173] (.002)	-
R^2	.84428	.65645	.82418	.70642	.67490
R-bar-squared	.82032	.64440	.80760	.68468	.65717
F-Statistic	2, 13 (.000)	2, 57 (.000)	5, 53 (.000)	4, 54 (.000)	3, 55 (.000)
Durbin's h-statistic	-	-	(.721)	-	(.087)
Diagnostic Tests**					
Serial Correlation	(.653)	(.057)	(.052)	(.053)	(.130)
Functional Form	(.011)	(.014)	(.022)	(.012)	(.135)
Normality	(.707)	(.174)	(.574)	(.915)	(.023)
Heteroscedasticity	(.135)	(.065)	(.216)	(.228)	(.203)
Predictive Failure	CHSQ [48]*** (.000)	CHSQ [4] (.057)	CHSQ [7] (.006)	CHSQ [6] (.000)	CSHQ [5] (.038)
Chow Test of Parameter Stability	CHSQ [3] (.000)	CHSQ [3] (.027)	CSHQ [6] (.003)	CSHQ [5] (.000)	CHSQ [4] (.013)

Values in brackets are {standard errors}, [t-values], and (p-values)

[⊗] Specification 3 to 5 represents the LSE approach, or the general to specific approach

* ARDL = autoregressive-distributed lag, DL = distributed lag and AR = autoregressive model

** From the diagnostic tests only the p-values will be reported

*** For Specification 1, only 16 observations were used. Upon deleting all observations that are not relevant, both null-hypotheses of adequacy of predictions and stability of the regression coefficients can be accepted at very high levels with p-values of (.538) and (.432) respectively. In using all 60 observations, diagnostic tests of functional form and normality proved p-values of (.000) for both tests, hence, rejecting the null-hypothesis of a correctly specified model and normally distributed disturbances.

Diagnostic tests through all specifications are at sufficiently high levels, even if the functional forms seems to be weak through specifications 1 to 4, it is still sufficient for this investigation. The measures of "goodness of fit" are at very high levels, fluctuating in a range of 66 % to 84 %. In specification 1 and 4 Q^F seems to be statistically insignificant, but the joint hypotheses of all coefficients being equal to zero can be rejected at the lowest levels through all specifications. The null-hypotheses of adequate predictions and parameter stability must be rejected in specifications 1, 3, and 4, saying that the predictive power of the data used for the RSEs are quite weak. The Durbin's h-statistic in specifications 3 and 5 are at very high levels, not rejecting the null-hypotheses of no first order auto-correlation.

In specification 1, only 16 observations could be used. By using more we had to reject the null-hypothesis of normally distributed disturbances. If the number of trades at the FSE goes up by 1 trade, the RSEs' price per trade increases by 0.2 EURO-cents, all other things being equal. An increase of 1 trade at the RSEs leads to a fall in prices of 0.8 EURO-cents per trade at the RSEs, ceteris paribus.

In specification 2, a 1 % increase in the number of trades of the FSE results in a 0.35 % decrease of the price per trade at the RSEs, all else equal, while a 1 % increase in the number of trades at the RSEs results in a 0.43 % decrease of the price per trade at the RSEs, other things remaining constant.

In specification 3 the ARDL model has been estimated. The estimate of the adjustment coefficient, δ, is (1 - .62005) = 0.37995. That is that the long run impact is 38 %, i.e., 38 % of the discrepancy between the desired and the actual price is eliminated in a year. The long-run function is given below:

$$P_j^{R*} = (9.1534/.37995) + (-.14652/.37995)Q_j^{F*} + (-.20523/.37995)Q_j^{R*}$$

$$= 24.09 - 0.39Q_j^{F*} - 0.54Q_j^{R*}$$

Increasing the number of trades at the FSE by 1 % decreases the RSEs' price per trade in Euro by .39 %, others things being the same. Increasing the number of trades at the RSEs by 1 % leads to a Euro price fall per trade of .54 % at the RSEs, ceteris paribus.

In specification 4, we calculated the long run statistics:

$$P_j^{R*} = 22.12 - 0.36Q_j^{F*} - 0.43Q_j^{R*}$$

In the long-run, a 1 % increase in the number of trades at the FSE results in a 0.36 % decrease in the price per trade at the RSEs, other things being the same. A 1 % increase in the number of trades at the RSEs leads to a decrease of the price per trade of 0.43 % at the RSEs, other things unchanged.

In specification 5 the estimate of the adjustment coefficient, δ, is (1 - .29585) = 0.70415. That is that the long run impact is 70 %. The long-run function is given below:

$$P_j^{R*} = (15.3557/.70415) + (-.21873/.70415)Q_j^{F*} + (-.32760/.70415)Q_j^{R*}$$

$$= 21.80 - 0.32Q_j^{F*} - 0.47Q_j^{R*}$$

In the long run, an increase of 1 per cent in the quantity of trades at the FSE leads to a decrease of 0.32 % of the RSEs' price per trade, other things held constant. An increase of 1 % in the quantity of trades at the RSEs leads to a decrease of 0.47 % of the price per trade of the RSEs, other things being unchanged.

No further lagged variables have been included into the dynamic models due to reasons explained for the case of the FSE.

2.3.4 Discussion of Results

The cost variance is the important variable in interpreting the results. The duty of having to reveal annual financial statements says nothing about the degree of information sharing. In the case of the German Financial Market it must be seen that the cost structure is very similar from market facility provider to market facility provider. Thus, the competitor can derive the cost structure from his own experience and from the data published by the FSE as well as by the RSEs. Without any doubt, the FSE does dominate the German Financial Market. The fact that the cost structure of the FSE is much more difficult to investigate without any insider information, leads us to the insight that the cost variance of the FSE is much greater than the ones of the RSEs.

The introduction of the Neuer Markt[12] segment at the FSE in March 1997 can be seen as another milestone of achieving Stackelberg Leadership, as this market attracts many private and institutional investors.

The major break-through of discount broker services added also to this evolution. The outstanding profit prospects of the Neuer Markt attracted lots of investors, both, private and institutional, especially during the Hausse (bullish market, i.e., a market of increasing prices) of spring 2000 (see annexe 3). This Hausse was mainly driven by the wish of countless private investors to make outstanding profits in a very short time. Moreover, the behaviour of financial analysts, who recommended shares of, for at this time, prospective companies looking for investment capital, nourished their belief of outstanding future activities. The stocks were absolutely overvalued compared to the value of the companies itself, e.g., software companies. As one result, the German Stock Markets crashed in 2000 to 2002, in particular, the Neuer Markt index NEMAX 50[13] dropped from 6,024 in January 2001 to 486 in July 2002, loosing more than 90 % of its value (see Monthly Statistics Cash Market July 2002 - Deutsche Boerse Information Products).

According to Albaek (1990) the greater $|\gamma|$ the greater are the uncertainty effects, the larger the spillover effects and the higher the profits resulting from the volatility of the costs of the other firm. As expected and from our econometric investigation of the market we can see that if a very short observation period is taken (e.g., in specification 1 only 16 observations), the uncertainty is not as huge as $|\gamma|$ is compared to an extended period.

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[12] "The Neuer Markt is a segment of Deutsche Boerse AG for the trading of shares, primarily of small to medium-sized domestic and foreign companies, which meet international standards of transparency and publicity (hereinafter simply referred to as "issuers"). Issuers are, in particular, innovative enterprises which develop new sales markets, utilize new methods of, for example procurement, production or distribution, or offer new products and/or services, and whose activities can be expected to generate high turnover and profits in the future." Rules and Regulations Neuer Markt, April 1, 1999.

Table 2.7: Values of Parameters

	N_i	β_i	γ_i	N_j	γ_j	β_j
Specification 1	60	-.0041185	.0045288	16	.0023485	-.0077560
Specification 2	60	-.91801	.42344	60	-.35011	-.42963
Specification 3	59	-.91	.38	59	-.39	-.54
Specification 4	59	-.91	.41	59	-.36	-.43
Specification 5	59	-.91	.38	59	-.32	-.47

However, one has to take into consideration while interpreting the results that the FSE has a much wider product range than the RSEs. Hence, even if more expensive some consumers will stick to the FSE than to other exchanges. Moreover, more turnover and more trades result in more liquidity in the financial market and most consumers are prepared to pay an even higher price for that higher liquidity. Nevertheless, arbitrageurs will bring back the market to an almost perfect equilibrium by using price differentials of the different German Market Places in order to make some profit.

Finally, it is investigated whether own effects dominate cross effects as this is one assumption of the theoretical model (see section 2), technically expressed as $\beta^2 > \gamma^2$. In other words, the effect of the quantity of good X on the price of good X is larger than the effect of the quantity of good Y on the price of good X, the so-called "cross-effect". Then, the "brand's measure of differentiation[14] $\delta = \gamma^2/\beta^2$ is discussed (see Shy [1995] and Gal-Or [1987]).

Table 2.8: Measure of Differentiation

2.8.1 Panel A: The Frankfurt Stock Exchange (including Xetra):

	N	α	β^2	γ^2	δ
Spec. 1	60	67987.1	.1839E-4	.1696E-4	.9222
Spec. 2	60	18.8018	.8427	.1793	.2128
Spec. 3	59	24.09	.2916	.1521	.5216
Spec. 4	59	22.12	.1849	.1296	.7009
Spec. 5	59	21.80	.2209	.1024	.4636

[13] The NEMAX50 index was launched on 1 July 1999 to enhance investor transparency for this segment an comprises the 50 most liquid Neuer Markt issues (see Guideline to Deutsche Boerse's Equity Indices, Version 4.1 - December 2000).

In Panel A "own effects" dominate "cross effects" through all 5 specifications. The measures of differentiation δ seem to be very close to 1 in specification 1, indicating a low differentiated market. In specifications 2 through 5, i.e., also when dynamic models are tested, the influence of lagged variables does change the brand's measure of differentiation much.

2.8.2 Panel B: The Regional Stock Exchanges:

	N	α	γ^2	β^2	δ
Spec. 1	16	46939.7	.5515E-5	.6016E-4	.6263E-4
Spec. 2	60	21.9117	.1226	.1846	.1506E-4
Spec. 3	59	19.25	.1444	.8281	.1744
Spec. 4	59	18.91	.1681	.8281	.2030
Spec. 5	59	19.29	.1444	.8381	.1744

In panel B we find the same situation, "own effects" dominate "cross effects". The brand's measure of differentiation δ is smaller through all specifications compared to the measures of the FSE in Panel A, saying that the FSE has more different stocks to trade than the RSEs, which is what one expects.

2.4 Conclusion

The basic underlying concept was introduced and several reasons have been discussed for playing Stackelberg instead of Nash, such as cost uncertainty (Albaek [1990]), learning curve effect (Ross [1986]), price-quality schedule (Kim [1987]), etc. The theoretical model of sequential decision making in a duopoly, developed by Stackelberg (1934) and extended by Albaek (1990), introducing a degree of information revelation, is the basic underlying of this paper. Albaek's model was discussed and a table with results of his corollaries was developed.

Then, as a next step, a stochastic model was constructed taking the theoretical model as basic underlying. Time series data of the "Real World" were used to investigate the behaviour of the regression coefficients in the short- and in the long-run,

[14] Brands are highly differentiated if a change in price of product i has a small or negligible effect on the demand of product j and vice versa. A brand is highly differentiated if $\gamma^2 \to 0$, it is an almost perfect substitute if $\gamma^2 \to 1$.

using different functional forms, i.e., a standard-linear and log-linear for each investigated case. Before starting with the regression analysis we tested the data series for unit roots and found that the data are non-stationary but a combination of this data series are stationary, that means, OLS can be applied. It was also tested for simultaneous equation bias and whether the trades at the Stock Exchanges are differentiated goods.

There were four findings: Firstly, trades at the considered stock exchanges can be seen as differentiated goods, secondly, playing a sequential game seems to be most beneficial for the players of the German Financial Stock Market, thirdly, the degree of information revelation seems to be greater in the case of the FSE than in the case of the RSEs, and, fourthly, own effects dominate cross effects.

The limitations of this paper however, are that, firstly, the conclusions made are restricted only to the observed period with 60 observations available, and, secondly, the data used are not optimal. Unfortunately, more precise data, i.e, trading fees only, are not published by the FSE and RSEs and, thus, "proxies" had to be used. Nevertheless, these data seem to be quite a good approximation, as the trading fees are a percentage of the amount traded.

Annexes

Annexe 1: Table 2.9: 9 Different Market Situations

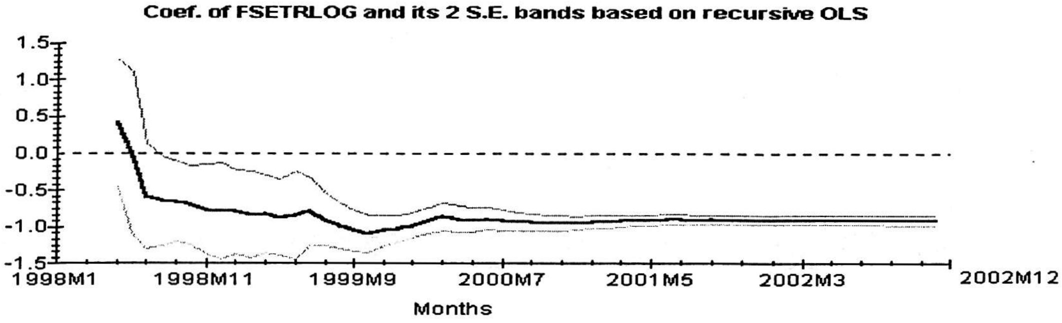
Supply / Demand	Perfect Competition	Oligopoly	Monopoly
Perfect Competition	Perfect Competition	Supply Oligopoly	Demand Monopoly
Oligopoly	Demand Oligopoly	Bilateral Oligopoly	Limited Supplier Monopoly
Monopoly	Demand Monopoly	Limited Demand Monopoly	Bilateral Monopoly

Source: von Stackelberg (1934)

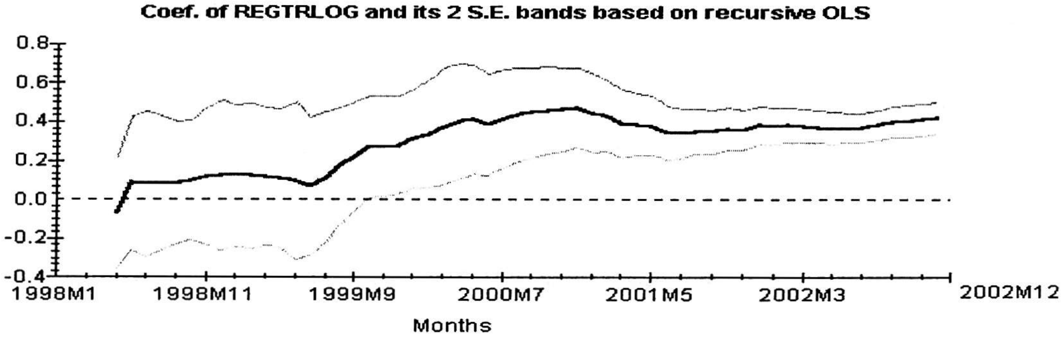
Annexe 2: Plots of Coefficients on recursive OLS (Log-linear)

Demand function i:

1) Behaviour of β_i:

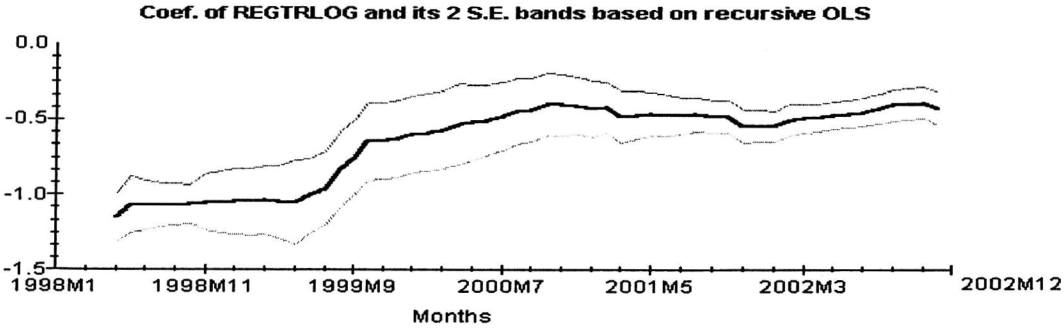


2) Behaviour of γi:

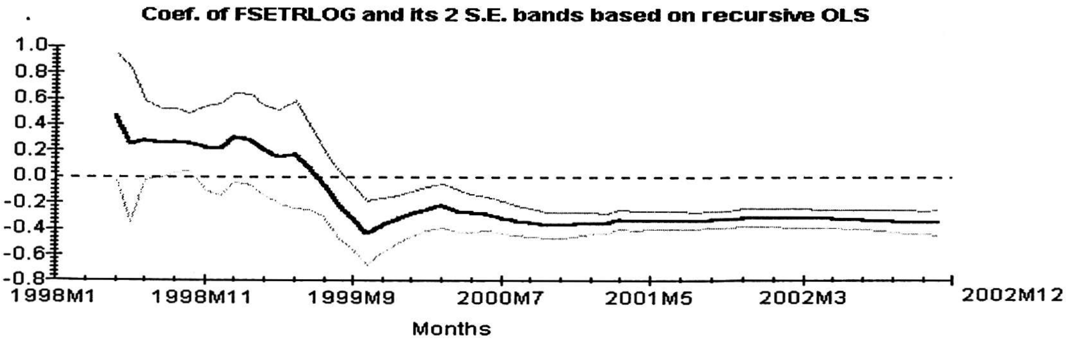


Demand function j:

3) Behaviour of β_j:

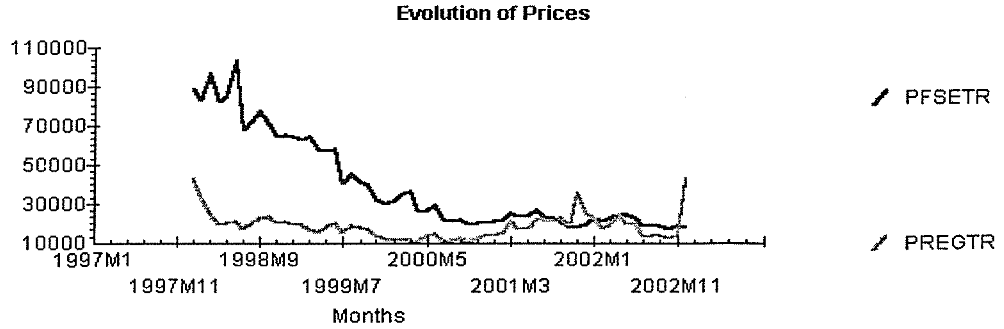


4) Behaviour of γ_j:

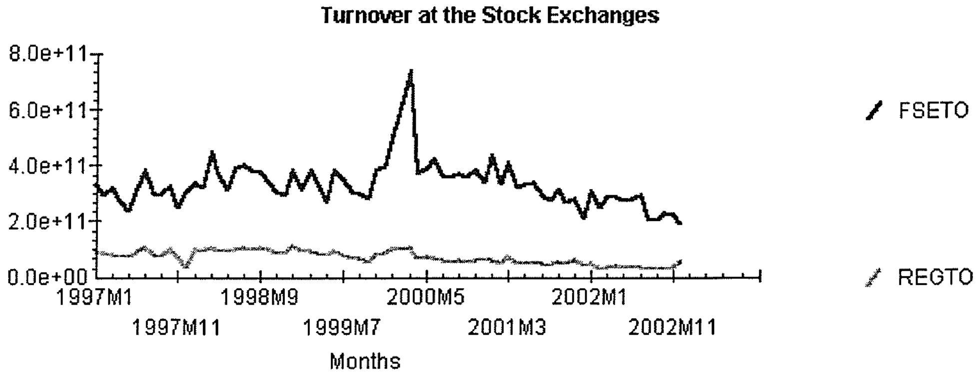


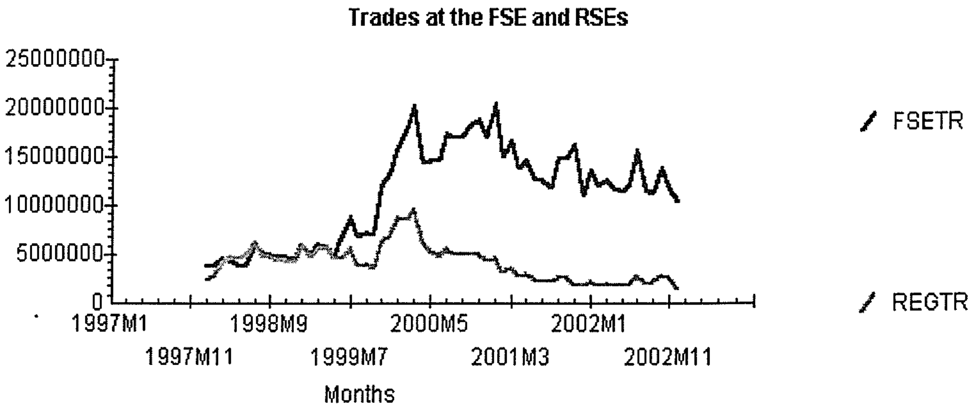
Annexe 3:

Graphs of the Evolution during the investigated period January 1998 to December 2002 (60 Observations)



The so-called "Prices" at the German Stock Exchanges are in fact average values, i.e., total turnovers divided by total trades. Of course, the total turnover contains not only prices charged by the stock exchanges, but also the price of the shares itself, courtages for the brokers etc. Nevertheless, for the purpose of this paper it is sufficient to use those average values as "proxies" for the prices charged by the stock exchanges.





Annexe 4:

Table 2.10: ADF-test statistics with trend*

2.10.1 Panel A: Standard-Linear Form

	PF	ΔPF	PR	ΔPF	QF	ΔQF	QR	ΔQR
ADF (1)	-1.8928	-6.4505	-2.4523	-3.9590	-1.4354	-5.2216	-2.2711	-4.0392
ADF (2)	-1.7523	-4.2895	-2.3107	-3.4249	-1.4731	-4.9460	-2.7424	-4.2520
ADF (3)	-1.7589	-3.7578	-1.1300	-2.8312	-1.2095	-3.5877	-2.3460	-3.4373
ADF (4)	-1.7294	-2.9951	-1.0798	-2.4459	-1.3663	-3.7306	-2.5006	-4.5989
ADF (5)	-1.7626	-2.8714	-1.0345	-2.3905	-1.1540	-3.1801	-1.7581	-3.7058
ADF (6)	-1.7131	-2.9342	-1.9530	-2.6875	-1.2077	-3.6817	-1.8003	-3.6947
ADF (7)	-1.6988	-4.1513	-1.6545	-2.4092	-.79334	-2.4874	-1.5685	-2.6627
ADF (8)	-1.7260	-2.9930	-1.7155	-1.8610	-1.1656	-2.5137	-1.7221	-2.6305
ADF (9)	-1.6890	-2.6771	-2.2010	-1.8916	-1.0593	-2.1745	-1.6574	-2.4774
ADF (10)	-1.6600	-3.3630	-2.1332	-2.3762	-1.2765	-2.1079	-1.5904	-2.2163
ADF (11)	-1.4536	-1.3993	-1.865	-3.2057	-1.2565	-1.7723	-1.5632	-1.6454
ADF (12)	-2.9126	-1.4697	-1.9510	-1.9414	-1.7242	-1.7778	-1.6977	-1.7440

*The 95% critical values see table 2.4

2.10.2 Panel B: Log.-Linear Form

	(L)PF	Δ(L)PF	(L)PR	Δ(L)PR	(L)QF	Δ(L)QF	(L)QR	Δ(L)QR
ADF (1)	-1.9084	-6.0894	-2.3511	-4.4120	-1.3858	-5.7316	-2.6099	-4.7624
ADF (2)	-1.6695	-4.0772	-2.1279	-3.4057	-1.3078	-5.1456	-2.2359	-4.3353
ADF (3)	-1.7871	-3.7468	-2.0777	-2.7108	-1.1283	-3.7954	-2.0407	-3.0461
ADF (4)	-1.6750	-3.1484	-2.1183	-2.6451	-1.2199	-3.6419	-2.3833	-3.7881
ADF (5)	-1.7285	-3.5049	-1.9844	-2.5602	-1.1252	-2.9523	-1.8499	-3.4047
ADF (6)	-1.3846	-3.5285	-1.9171	-2.7222	-1.3398	-3.4385	-1.8043	-3.6831
ADF (7)	-1.1508	-4.6068	-1.6924	-2.6051	-.91595	-2.3053	-1.5295	-2.9878
ADF (8)	-.56780	-3.2847	-1.6346	-1.8805	-1.2649	-2.4601	-1.5463	-2.5582
ADF (9)	-.75338	-2.8666	-2.2014	-1.7885	-1.1215	-2.4559	-1.5894	-1.9392
ADF (10)	-.79740	-3.0785	-2.2691	-2.3673	-1.0273	-2.2745	-1.7927	-2.1366
ADF (11)	-.54435	-1.9756	-1.7869	-2.6115	-1.0453	-1.7163	-1.6167	-1.6222
ADF (12)	-1.7175	-2.0230	-1.6606	-1.1869	-1.7453	-1.8498	-1.7019	-1.5985

*The 95% critical values see table 2.4

The results clearly show the danger of testing for a unit root in a too restrictive model. The AR(1) model and the resulting DF-statistics do not suggest that the null-hypotheses of unit roots will be rejected. However, first differenced data suggest to reject the null-hypotheses of unit roots for the AR(1) model. Given monthly data, seasonal patterns in prices are not uncommon. ADF tests of higher orders suggest, however, not to reject the null-hypotheses of unit roots. For the log of the data we find a set of rather similar sets. The conclusion is the same: we do not reject the null-hypotheses of unit roots.

Chapter three: Optimal Listing Policy for IPOs in the German Financial Market

3.1 Introduction

Since the introduction of the Neuer Markt (New Market[15]) segment[16] of the Frankfurt Stock Exchange in March 1997, hereinafter simply referred to as FSE, a firm's decision to go public is influenced by either gaining from sponsorship of the Neuer Markt, where financial intermediaries act as market makers to secure liquidity in a certain stock, but having a worse reputation, or from higher liquidity in the 1st Segment. Traditionally, smaller firms were traded over the counter (OTC) and as they grew larger they listed on the Regional Stock Exchanges[17] and then on the 1st or 2nd segment of the Frankfurt Stock Exchange (see FWB The Frankfurter Wertpapierboerse, June 1998).

This study reports the rapid growth of the German IPO trend from March 1997 to December 2000 and the fall of the trend to go public due to the crash of 2000/2001 where the Neuer Markt index fell from over 8,000 points down to less than 600 points especially after the September 11, 2001 attacks against the United States of America.

This paper contributes to the specific literature in analysing the initial listing decision of IPOs in the German Financial Market using a unique data set and constructing quantitative as well as qualitative variables that have not been available so far, such as Market Value, Market-to-Book, and Dual-International-Listing variables as well as the determination of qualitative variables that have been used in the US and have now been constructed for German circumstances, such as Technology Firm and Industry Dummy Variables. An additional contribution is the development of assigned ranks of designated sponsors in Germany which is similar to the one developed by

[15] The difference between the Nasdaq and the Neuer Markt is that the Nasdaq stock market consists solely of computerised linkages among securities dealers while trading on the Neuer Markt is also possible on the floor and on the computerised trading platform XETRA. Moreover, while the Nasdaq has no central order book, the Neuer Markt consolidates most of its trades in an order book, except those which are directly entered into the trading system.

[16] In addition to the Neuer Markt, a network of several Stock Exchanges, including French and German Stock Exchanges, created the so-called Euro-NM, which has been interpreted as an attempt to protect market shares.

[17] Some firms started to be listed on the Regional Stock Exchanges and moved then to the Frankfurt Stock Exchange. Nowadays there are very few firms that list solely on a Regional Exchange. However, many firms are listed solely on the Frankfurt Stock Exchange (see Deutsche Boerse Factbook 2001)

Carter and Manaster (1990) for US-underwriters and which can be seen as unique. This analysis provides more powerful tests for IPOs and involves factors such as firms' age, follow-on strategies, listing fee differences, expected de-listing costs, dual international listing, etc.

It is organised in that way that in sections 1 and 1.1 a pure introduction and literature review is given, respectively. Sections 1.2 and 1.3 discuss institutional features and listing and de-listing requirements. This background information is useful to provide an overall understanding of the paper. Section 2 presents the model from Aggarwal and Angel (1997), in section 3 the empirical analysis is conducted, reviewing the data and using a Probit model. Section 4 summarises and concludes.

3.1.1 Literature Survey

Firms prefer to list their stocks on a highly liquid secondary market. Liquidity is seen as a valuable security attribute by academics and practitioners. However, little research has been done so far in measuring the variable liquidity and the concept itself is hard to define. Ceteris paribus, an asset with lower transaction costs can be regarded as more liquid than an asset with higher transactions costs (see Aggarwal and Angel [1997]). Chordia, Roll, and Subrahmanyam (2001) investigate aggregate market spreads, depths, and trading activity over an extended time sample. They come to the conclusion that liquidity plummets significantly in decreasing markets. Moreover, they discover that there are strong day-of-the-week effects; while Tuesdays accompany strong and significant increases in the trading activity and liquidity, Fridays show the opposite pattern. They argue that the influence of trading costs on required returns, exchange organisation, regulation, and investment management could be positively influenced by the knowledge of these factors and should increase investor confidence (see also Jacoby, Fowler, and Gottesman [2000]).

Roell (1996) and Pagano, Zingales, and Panetta (1996) report that the most frequent reason for going public is to raise capital. The need to raise capital comes out of the need to undertake new investment projects.

Aggarwal and Angel (1997) predict that small and risky firms, as well as firms valued primarily from growth options will list on a high service market, i.e., in our case the Neuer Markt with its designated sponsorship. Currently there are more than 1000 shares supported by such market makers. Mainly, banks and securities firms act as designated sponsors. At present, there are 63 of 71 active designated sponsors in equities of the Neuer Markt (see Rating of Designated Sponsors for the third quarter of 2001, Deutsche Boerse, October 2001).

Cybo-Ottone (2000) shows that most exchanges within the European Union are controlled by financial intermediaries, while Lee (1998) analysis the governance structure of exchanges. He shows that members of the exchanges[18] (trading intermediaries) strongly influence the exchanges' decision.

Foucault and Parlour (2001) develop a model where two exchanges compete for listings on the basis of listing fees and trading costs. They conclude that large IPOs list on the market segment with lower trading costs and higher listing fees, while smaller and riskier IPOs list on high service market segments with higher service costs and lower trading costs. Amihud and Mendelson (1986) show that high expected trading costs give a signal to investors to require higher rates of return. Foucault et al. (2001) argue that this is the reason that entrepreneurs who seek to raise money prefer a market with lower trading costs, ceteris paribus. While Madhavan (1992) conducted a theoretical comparison of trading costs, Bessembinder (1999) estimates trading costs in Nasdaq and NYSE. He finds that in 1997 the bid-ask spreads on Nasdaq are larger than on NYSE (see also Sanger and McConnell [1986] and Sanger and Peterson [1990]).

Merton (1987) derives a model where a firms' value increase with investor recognition. Managers of the FSE cite that increased visibility is a reason for listing on the 1st Segment (see FWB The Frankfurter Wertpapierboerse, June 1998). Baker, Powell, and Weaver (1999) find that increased recognition by analysts and institutional shareholders can be primarily explained by growth in market capitalisation than the listing itself. According to Baker and Johnson (1990) managers cite visibility and improved access to investors as one of the most important decision criteria in the IPO's

[18] Companies which are commercially active in the securities business, such as banks, financial service firms, financial companies and other corporate agents are normally admitted to dealing on the Frankfurt

listing process. Gehrig, Stahl and Vives (1996) analyse the role of informational asymmetries between domestic and international investors on exchanges located in different countries. They conclude that if domestic and foreign investors have identical information (no differentiation between exchanges) there is a concentration on a single exchange, while if these investors have different information two exchanges can co-exist and attract different listings.

However, in the Neuer Markt segment designated sponsors (market makers) commit to the IPOs by taking sizeable positions in their proprietary accounts, using institutional contacts and networks, as well as maintaining research coverage or fulfilment of compulsory disclosure. Aggarwal and Angel (1997) propose that incentives to provide sponsorship can be derived from wider bid-ask spreads and the designated sponsors' ability to internalise order flow in the dealer market.

Previous research on listing policy has been conducted on firms that switch from one market to another, e.g., Nasdaq firms switch to NYSE or AMEX. Clyde, Schultz and Zaman (1996) conduct an interesting empirical study and find a paradox: firms have a positive price reaction when they switch from Nasdaq to the Amex and vice versa. Corwin and Harris (2001) study Initial Public Offerings (IPOs) between 1991 and 1996 on either NYSE or Nasdaq. They restrict their investigation to IPOs that fulfil requirements for both markets and find that the post IPO market value of firms on NYSE are much larger than on Nasdaq, e.g., for a firm issuing 5 million of shares at $5, the initial listing fee on Nasdaq is roughly 0.0375 % while on NYSE it is 0.1058 % of the market value. Also re-investigating for seasoning strategies they find no evidence of such firms for a preference for a specific market segment.

3.1.2 Institutional Features

Securities intended for trading on one of the segments of the Frankfurt Stock Exchange must fulfil certain requirements (see section 1.3.). This is to ensure the prescribed disclosure of information to investors.

Stock Exchange. Exchange members must fulfil certain requirements such as approval by exchanges'

Together with a trading admitted bank the issuer applies for listing. Then, the issuer must provide a prospectus in the first segment or a corporate report for the second segment. In addition, balance sheets, accounts, etc. must be submitted. In the Neuer Markt segment all documents submitted must correspond to International Accounting Standards (IAS) and United States-Generally Accepted Accounting Principles (US-GAAP). Then, in fulfilling the requirements the Board of Directors of the Deutsche Boerse examines the documents and admission can take place (see Ihr Boersengang Leitfaden fuer Emittenten zu Going Public und Being Public, Deutsche Boerse, September 2001).

The Deutsche Boerse has separated the market into several market segments in order to tailor underlying requirements to companies that want to raise capital on the German Financial Market. Market segments are 1st segment (official trading[19]), 2nd segment (regulated market), Neuer Markt segment, 3rd segment (mainly foreign shares and options), SMAX (smaller companies that do not meet Neuer Markt requirements, but fulfil 2nd segment requirements and want to gain from a designated Sponsorship), and XTF Exchange Traded Funds (segment for investment funds) (see FWB The Frankfurter Wertpapierboerse, June 1998)

General Managers, etc.

[19] "This is the market for securities admitted to official listing by the Listing Board of the Stock Exchange on application jointly submitted by the issuer and a bank admitted to the Stock Exchange. Companies that wish to list their shares for official trading are obliged to submit a detailed offering prospectus before going public. In addition, there are also stringent disclosure, notification and publication requirements concerning running operations, such as publication of the annual financial statements and interim reports in the authorised journals for the publication of mandatory Stock Exchange announcements. Official brokers determine those prices that are of an official nature, i.e. the investor is entitled to have orders filled at the determined price." Source: NeuerMarkt.com AG, FAQ.

3.1.3 Listing and De-listing Requirements

Table 3.1: Summary of Listing and De-Listing Requirements and Historical Evolution*

3.1.1 Panel A: The Trading Segments of the Frankfurt Stock Exchange

1st Segment (Official Trading)	**2nd Segment (Regulated Market)**	**Neuer Markt (New Market)**	**SMAX**	**3rd Segment (Regulated Unofficial Trading)**
- Minimal market value of Euro 1.25 mill - existence for at least 3 years - published annual statements for the previous 3 years - 25 % of shares must be held by the public - issue prospectus must be attached to the listings application - annual report and interim report must be published - De-listing due to an insufficiency of assets or if insolvency proceedings have been initiated	- minimal nominal value of listed securities is Euro 0.25 million - a company report must be attached to the application - no requirements for the corporation's age - De-listing due to an insufficiency of assets or if insolvency proceedings have been initiated	- minimum issue volume of Euro 5 mill - 25 % of shares must be held by the public - contractual obligation for at least 2 designated sponsors - lock up period of six months for original shareholders - acceptance of German take over code - publications in German and English - IAS (International Accounting Standards) required - De-listing due to an insufficiency of assets or if insolvency proceedings have been initiated	- meet requirements for 2nd market segment - contractual obligation for at least 1 designated sponsor (from January 1st, 2002 on there is contractual obligation for 2 designated sponsors) - De-listing due to an insufficiency of assets or if insolvency proceedings have been initiated	- only few admission requirements such as a guarantee for orderly trading and orderly settlement of securities transactions - De-listing due to an insufficiency of assets or if insolvency proceedings have been initiated

* Source: FWB Rules and Regulations, Deutsche Boerse June 1999

3.1.2 Panel B: Historical Evolution Nasdaq vs. Neuer Markt

	NASDAQ		**Neuer Markt**	
	IPO Listings	**IPO Delistings**	**IPO Listings**	**IPO Delistings**
1997	494	717	12	-
1998	273	806	39	-
1999	485	873	124	2
2000	397	700	132	2
2001	63	770	11	26

Source: neuermarkt.com Listing Center

Panel B points out the less developed nature of the Neuer Markt Segment compared to Nasdaq it was modelled on. In the period of January to December 2002 only 2 German IPOs went public in the 1^{st} and in the Neuer Markt segment (see neuermarkt.com Listing Center).

3.2 The Model

In the model of Aggarwal and Angel (1997) it is assumed that the fraction of investors, q, who know about the existence of a certain stock is less than the total number of investors in the market. Moreover, a higher bid-ask spread[20] is associated with higher rates of return (see Amihud and Mendelson [1986]). Hence, as fewer investors than the total number know about a certain stock, this causes an increase in the required rate of return, λ, that is as well a function of firm size and idiosyncratic risk[21] (see also Merton [1987]):

$$\lambda = ((1-q)/q)x\delta\sigma^2 \qquad (1)$$

where x is the weight of the firm in the market portfolio, δ is the common risk aversion parameter for each investor, and σ^2 is the idiosyncratic risk of the stock.

Moreover, the fraction of investors knowing about a stock if traded on the Neuer Markt (New Market) is denoted q_{NM}, while the fraction of investors knowing about a stock if traded on 1^{st} segment is denoted q_{1st}. We assume that prestige[22] or other intangible benefits[23] is captured by market segment membership, i.e., q_{NM} or q_{1st}.

It is assumed that an extra return, γ, required to compensate investors for a higher bid-ask spread is related to the relative bid-ask spread S. In order to keep the model as simple as possible, it is assumed that the model is linear with a constant of proportionality α:

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[20] "The bid-asked spread is a transaction cost for exchanging an asset. The bid price is the highest price bid by potential buyers. It is always below the asked price. The asked price is the lowest price at which potential sellers offer to sell." See Francis (1993), p. 461

[21] Literature distinct between diversifiable and undiversifiable, liquidity and domestic as well as international political risk, the call risk and the convertibility risk, see Brennan and Schwartz (1980) and Milton and Raviv (1985) as well as Francis (1993).

[22] It is important to note that this prestige affects the portion of investors who know about the firm if traded in a particular market.

[23] The value of prestige and intangible benefits will of course differ across firms.

$$\gamma = \alpha S \qquad (2)$$

The bid-ask spread in the Neuer Markt is denoted S_{NM}, in the 1st segment it is S_{1st}. It is assumed, other things being the same, that more investors know about a certain firm in the New Market than in the 1st segment, $q_{NM} > q_{1st}$. This is due to the higher Marketing paid for by the higher bid-ask spread, $S_{NM} > S_{1st}$.

The questions arises why under such circumstances a firm should stay on the FSE's 1st segment instead of changing to the Neuer Markt segment. Baker, Powell, and Weaver (1996) found, that NYSE (the equivalent to 1st segment) listing increases firm visibility which was measured by analyst coverage. In the theoretical case of no listing fees, a firm will surely choose the market with the lowest cost stemming from the frictions $\gamma + \lambda$. Hence, a firm will stay listed on the Neuer Markt as long as

$$\gamma_{NM} + \lambda_{NM} < \gamma_{1st} + \lambda_{1st} \qquad (3)$$

Substituting (1) and (2) into (3) yields:

$$((1-q_{NM})/q_{NM})x\delta\sigma^2 + \alpha S_{NM} < ((1-q_{1st})/q_{1st})x\delta\sigma^2 + \alpha S_{1st} \qquad (4)$$

Furthermore, it is assumed that the number of shares listed and the issue amount in EURO is roughly proportional to a firm's size. Since fees of the FSE are based on the issue amount in EURO (see appendix 1, fee schedule for the 1st segment and for the Neuer Markt), they can be modelled as a constant addition to the cost of capital, C_a, on an annual basis. Substituting this term into (4) leads to the proposition of optimal listing policy of Aggarwal and Angel (1997) "... that a firm will prefer the dealer market (Neuer Markt) if the benefits in reduced cost of capital from greater exposure in the dealer market (Neuer Markt) are significantly greater than the benefits of reduced bit-ask spread in the auction market (1st segment) less annualised maintenance fees, C_a":

$$((q_{NM} - q_{1st})/q_{1st}q_{NM}))x\delta\sigma^2 > \alpha(S_{NM} - S_{1st}) - C_a \qquad (5)$$

Hence, the best market for a firm is a function of the spreads in the different market segments, the relative visibility in the two segments, and the firm's idiosyncratic risk, size, and overall investor risk aversion.

3.3 Econometric Analysis

In the following, in section 3.1 data and sample characteristics are being investigated, then, in section 3.2 a probit model is used to examine the listing decisions of IPOs going public.

It is assumed that investors knowledge q about a firm is positively related with the market value of the firm, i.e., the higher the market value the more known firms are to the public. Hence, market value captures the weight of the firm in the market portfolio, x. Risk σ^2 is covered by the variable Grennshoe offer proceeds, which serves as a proxy for ex ante uncertainty about the value of the offer. As an additional proxy for ex ante uncertainty we include a variable covering the firm's age, as the older the firm is, the more secure their shares can be seen (taking into consideration, that they just went through an IPO process, meaning that their business plan was investigated by independent auditors who found that the concept is worth for going public). Listing fee difference S covers the different marketing costs paid by firms joining either the Neuer Markt segment or the 1st market segment. Finally, annualised maintenance fees C_a are investigated by the Market-to-Book variable. Moreover, we test for different qualitative variables, in order to investigate the influences of attributes like dual international listings, technology firms and industry firms to the listing decisions.

.Even if the analysis follows the one of Corwin and Harris (2001), there are differences in variables which are due to the fact that the German financial market is less developed than the US market. While they use dummy variables on reverse LBOs (companies switching from one stock exchange to another) and Carveouts (parent firms are listed at a certain stock exchange), such behaviour can rarely be found in the German financial market due to the very short existence of the Neuer Markt segment and the limited number of firms that went public so far. During the investigated period there were no so-called follow-on strategies (issuing additional shares after several months of listing) used by German IPOs, hence, we use the Greenshoe offers (in US terms called overallotment options), which is a stock reserve for market makers, to sell as many as roughly 15 % more, as seasonal strategies.

3.3.1 Data and Sample Characteristics

The sample comprises 362 IPOs between March 1997 and December 2001 that listed on one of the market segments noted below.

Data was collected from monthly published cash market data of Deutsche Boerse Information Centre, as well as from the Neuer Markt information company, neuermarkt.com, where company profiles, sales and marketing prospectuses, annual reports, financial statements, other business figures such as cash-flow, number of employees, sales per employee, etc., mission statements, designated sponsors' and underwriters' descriptions and their Xetra rating, ad hoc messages and so forth can be down-loaded free of charge for each existing IPO since the introduction of the Neuer Markt segment in March 1997.

Table 3.2: Frequency of Initial Public Offerings by Market Segment

3.2.1 Panel A: Frequency of IPOs by Year

Year	**1st Segment (Official Trading)**	**Neuer Markt**	**SMAX**	**Total**
March 1997	0 (0%)	11 (92 %)	1 (8 %)	12 (100 %)
1998	0 (0 %)	39 (90 %)	4 (10 %)	43 (100 %)
1999	2 (1 %)	124 (86 %)	19 (13 %)	145 (100 %)
2000	5 (3 %)	132 (90 %)	10 (7 %)	147 (100 %)
All of 2001	1 (7 %)	11 (73 %)	3 (20 %)	15 (100 %)
Total	**8 (2 %)**	**317 (88 %)**	**37 (10 %)**	**362 (100 %)**

Panel A of table 3.2 lists the frequency of IPOs and their respective market segment. While only 2 % of all IPOs in the reported period listed on the 1st segment (official trading), 88 % listed on the Neuer Markt and 10 % on the segment for smaller companies, that did not qualify for the Neuer Markt segment. The portion of the companies going public in the 1st segment (2%) is very small compared to the SMAX

(10%) or Neuer Markt (88%) segment. The reason for that can be seen in the market sponsorship of the Neuer Markt and its identification as high growth market in the public. The portion of IPOs going public in the 1st segment during 1997 and 1998 is even 0. This was due to the very successful launch of the Neuer Markt segment and its reputation for outstanding profit opportunities. The impact of the "Crash 2000/2001", when the index lost more than 7,000 points, can be seen in the rapid growth of IPOs in the 1st segment compared to the Neuer Markt growth in 2001, while the proportion of IPOs going public on the first segment increases by 4 % from 3 % to 7 % in 2000 and 2001 respectively, the proportion of IPOs going public on the Neuer Markt decreases by 17 % from 90 % to 73 % in the same period.

After having further examined the 362 companies it was found that only 261 qualified for both market segments, but further data such as balance sheets, profit and loss accounts, annual reports, was only available for 252 companies as meanwhile 9 of the IPOs went bankrupt and perished from the Neuer Markt. Most of the IPOs qualifying for the Neuer Markt segment but not for the 1st segment were founded only for a listing in the former segment. Hence, they did not fulfil the 3 years incorporation requirement needed for the 1st market segment.

In the following we do only examine the remaining 252 IPOs. Data of most balance sheets and profit- and loss accounts were issued in both existing currencies, namely Deutschmark and Euro. Where only Deutschmark was used, the amount was translated at the officially fixed exchange rate of Euro 1 = DM 1.95583. Very few companies (5 companies) published their balance sheet, profit and loss account, cash flow analysis and their descriptions using US-$ as currency (especially where companies are also listed on other domestic and international exchanges). Here, the exchange rate 1 Euro = 0.89 US-$ was used as this is the average of the not strongly fluctuating exchange rate during 2000/2001.

The next panel lists frequencies for all 252 sample IPOs based on offer proceeds. Offer proceeds equal offer price multiplied by offered shares (excluding Greenshoe).

3.2.2 Panel B: Frequencies of IPOs by Offer Proceeds

Offer Proceeds	**1st Segment**	**Neuer Markt**	**Total**
< EURO 5 mil	2 (66%)	1 (33%)	3 (100%)
EURO 5 mil - < EURO 10 mil	0	3 (100%)	3 (100%)
EURO 10 mil - < EURO 20 mil	0	33 (100%)	33 (100%)
EURO 20 mil - < EURO 30 mil	0	48 (100%)	48 (100%)
EURO 30 mil - < EURO 40 mil	0	36 (100%)	36 (100%)
EURO 40 mil - < EURO 50 mil	0	29 (100%)	29 (100%)
EURO 50 mil - < EURO 100 mil	0	64 (100%)	64 (100%)
≥ EURO 100 mil	5 (14%)	31 (86%)	36 (100%)
Total No of IPOs	**7 (3%)**	**245 (97%)**	**252 (100%)**

Panel B clearly shows the understanding of the Neuer Markt as a high growth market for young companies. Companies exceeding proceeds of Euro 100 mil are using the 1st segment more frequently than smaller companies. Nevertheless, the proportion of companies that prefer the Neuer Markt is still outstanding compared to the proportion going public on the 1st segment. This is clear evidence that companies prefer the market sponsorship of the Neuer Markt in order to improve their shares' liquidity and make them more known to the public.

In the following, the contents of table 3.3 Panel A & B as well as table 3.5 have been tested for normality, i.e., if the sample from the population follows a Gaussian bell-shaped distribution. The KS-test (Kolmogorov-Smirnov-test) showed for all variables under investigation p-values of this test < 0.0001, i.e., the population is unlikely to be Gaussian. Hence, a non-parametric[24] test has been conducted, the so-called Wilcoxon rank test (also called Mann-Whitney-U-test, see Corwin and Harris, op. cit.). This is a test of equality of medians across market segments (i.e., populations) based on the analysis of variance. With a small p-value (e.g., $p < 0.050$) we can reject the idea that the medians are equal. In other words, population 1 has a different median as population 2 (for all calculations of the p-values the software package "GraphPad Instad Version 3.00" has been used), i.e., variables do differ significantly in both markets.

[24] Non-parametric tests make fewer assumptions about the distribution of the data, e.g., the data is not sampled from a Gaussian distribution but still from a distribution symmetrically distributed around their median (see Gujarati [1995]).

Table 3.3: Summary Statistics for Firm and Offer Characteristic

3.3.1 Panel A: Offer Characteristics

Variable*	N	1st Segment	Neuer Markt	Total	p-value[25]
Offer Proceeds in Mil Euro	252	7,696 (1,099) [31%]	17,546 (72.16) [69%]	25,242 (100.16) [100%]	U** = 1,399 (.005)
Offered Shares Mil	252	330 (47.14) [31%]	728 (2.97) [69%]	1,058 (4.20) [100%]	U = 1,423.5 (.003)
Average Offer Price	252	23.21	25.22	25.16	U = 615.5 (.204)
Underwriter Market share (%)	252	2.14	2.05	2.05	U = 967 (.567)
Underwriter Ranking[26]	252	9.0	7.46	7.46	U = 6,100.7 (.433)

* Values are absolute, (mean), and [relative]

** U = the sum of ranks from the positive differences (see Kanji [1994] and Daniel [1978])

Carter and Manaster (1990) develop a system of ranking of underwriter reputation which is "not unlike the starring order appearing in Hollywood's billboards" (see Carter, et al. [1998]). They derive an underwriter reputation variable which was motivated by the work of Hayes (1971). Their suggestion was that investment banking industry is subject to a rigid hierarchy. The higher in the hierarchy the more prestigious and lucrative positions are held. Hence, underwriters aggressively defend their position in the hierarchy which is reflected in so-called "tombstone announcements". Such announcements do not yet exist in the German Financial Market and, thus, an existing rating is used and ranks are assigned to each rating (see annexe 1). However, company profiles of all IPOs can be downloaded from neuermarkt.com. There, all underwriters and designated sponsors are noted.

All offered proceeds in panel A of table 3.3 are in million Euro and offered shares are in millions. Average Offer Price is the sum of all offered prices divided by number of IPOs. Underwriter market share is the proportion of all IPO proceeds in the

[25] The p-value is also called the exact level of significance or the exact probability of committing a type I error, in other words, the lowest significance level at which a null hypothesis can be rejected.

[26] As all underwriters act also as designated sponsors the rating for DS has been used (see appendix 3). The calculation of the ranking is simply the sum of all rankings divided by the number of underwriters.

observed period "... for which a particular underwriter served as lead underwriter" see Corwin and Harris (2001), p. 44. Underwriter rankings are given in annexe 1.

Panel A of Table 3.3 demonstrates that significant differences exist between the two market segments. Even if only 2 % (see Panel A of table 3.2) of all IPOs in the reported period choose to list on the 1st market segment, they represent 31 % of all offered proceeds and offered shares. Moreover, one can easily see that IPOs in the 1st segment are also underwritten by higher quality underwriters, as reflected in the ranking in annexe 1. The underwriter market share is 2.14 % at 1st segment compared to 2.05 % at Neuer Markt confirming that IPOs at 1st segment are underwritten by higher quality underwriters. This finding is consistent with the finding of Corwin and Harris (2001) who report that the underwriter market share in the NYSE is higher than in Nasdaq, i.e., NYSE IPOs are underwritten by higher quality underwriters.

Non-parametric tests of variances show very low p-values for offer proceeds and offered shares, rejecting the idea that medians of both populations are equal, which was expected. However, for average offer price, underwriter market share and underwriter ranking, we do not reject the null hypotheses of equal medians of the two populations, saying that on the average in both market segments the variables do not differ much.

3.3.2 Panel B: Firm Characteristics

Variable*	N	1st Segment	Neuer Markt	Total	(p-value)
Total Assets in Euro Million	252	3,771 (538.71) [18%]	17,493 (71.4) [82%]	21,264 (84.38) [100%]	U = 409 (.019)
Market Value in Euro Million	252	7,868 (1,098) [25%]	24,357 (99.42) [75%]	32,225 (127.88) [100%]	U = 247 (.001)
Firm Age	252	(33.72)	(14.23)	(14.84)	U = 1,715 (.000)
Market-to-Book	252	13.53	6.61	6.80	U = 1,715 (.000)
Venture Capital[27] [% in sample]	252	7 [7%]	96 [93%]	103 [100%]	-
DIL [% in sample]	252	1 [11%]	8 [89%]	9 [100%]	-

* Values are absolute, (mean), and [relative] figures

Panel B of table 3.3 presents the company characteristics of the IPOs. We define total assets as fixed assets consisting of intangible assets, tangible assets, and financial assets plus current assets consisting of inventories, receivables, and other assets, as well as cash-in-hand and bank balances summed up in the balance sheet[28] for the fiscal year prior to the public issuing event. The market value is defined as the offer price multiplied by all shares outstanding as of the issue date without Greenshoe reserve. Firm age equals the number of years from the incorporation date to the issuing date. Market-to-Book is the market value of equity, plus the book value of debt, consisting of provisions and liabilities such as bank loans, advances received from customers, trade payables, liabilities to related parties, and other liabilities, divided by total assets as defined above. Venture capital is simply the number of IPOs which are backed by other companies' capital, holding at least 17 % of the total volume of all shares prior to the issuing event. DIL is the number of IPOs being internationally dually listed.

[27] Venture capital backed IPOs are identified if a significant portion of their shares are held by large companies. The significant portion should exceed at least 25 % of all shares (see also Megginson and Weiss[1991]). However, in this paper the portion is at least 17 % as in the German Financial Market many IPOs are backed by 17 % and more.

[28] All balance sheets used for this paper have been audited and were conform to the German Commercial Code (HGB) and US-GAAP as well as IAS and afterwards published. If differences arose between

IPOs' characteristics differ significantly across market segments. As expected, Neuer Market IPOs have significantly lower mean total assets and mean market values than 1st segment's IPOs. The average firm's age and the market-to-book ratio, however, are on the 1st segment significantly higher than on the Neuer Markt segment, while venture backed IPOs and dual international listings are on the Neuer Markt segment significantly higher than on 1st segment, with 93% to 7% and 89% to 11% respectively. Hence, IPOs associated with DIL and venture backed capital are more likely to list on the Neuer Markt, while a high firm's age and a high market-to-book ratio give evidence for preferred listing on the 1st segment. This is confirmed by the non-parametric tests that all null-hypotheses of equal medians can be rejected at sufficient levels.

Table 3.4: IPO Firms by Industry

Industry	**Number of IPOs**	**% of IPOs Listed**
Automobile	5	1.98
Chemicals	1	0.4
Consumers	1	0.4
Financial Services	4	1.59
Industrial	9	1.98
Media	29	11.51
Pharma (incl. Bio-tech)	19	7.54
Software	109	43.2
Technology	62	24.60
Telecommunications	8	3.17
Transport	5	1.98
Total	**252**	**100**

In table 3.4 we use the industries as defined by the FSE (see FSE Factbook 2001). The sample includes all 252 firms that either listed on the 1st segment (official trading), or met the 1st segment's initial listing requirements but listed on Neuer Markt. Thus, table 3.4 provides strong evidence that software firms, which are not identified as technology firms, represent the highest portion of initial public offerings (43.20 %). This is followed by technology firms, capturing 24.60 % of all initial public offerings. Media and Biotechnology (Pharma) firms represent only 11.51 % and 7.54 % of the

figures of balance sheets using different rules, i.e., HGB of IAS, the IAS conform balance sheet had been used.

investigated portion of IPOs. The rest are minor market segments of IPOs, not worth interpreting it.

Table 3.5: Greenshoe Offers by IPO Firms

Variables*	**1st Segment IPOs**	**Neuer Markt IPOs**	**All IPOs**	**p-values**
Number of Issuers	6 (0.86) [3%]	181 (0.72) [97%]	187 (0.72) [100%]	-
Number of executed Greenshoe Offers	6 [3%]	176 [97%]	182 [100%]	-
Greenshoe Offers in Euro Million	220 (1.013) [9%]	2,317 (1.002) [91%]	2,537 (0.3065) [100%]	U = 458 (.036)
Mean Scaled Greenshoe Offer Proceeds in Euro Million [%]	[0.09 %]	[0.22 %]	[0.19 %]	-

* Values are absolute, (median), and [relative]

We define total number of issuers as all IPOs offering Greenshoe reserve. As not all IPOs executed their reserve, the number of executed Greenshoe offers is different to the total number. The mean number of Greenshoe offers is the number of executed Greenshoe offers divided by the number of IPOs as per market segment. The mean Greenshoe offer proceeds equals the segmented Greenshoe proceeds divided by segmented total number of Greenshoe offer proceeds, while mean scaled Greenshoe offer proceeds is the segmented Greenshoe offer proceeds divided by segmented IPO Greenshoe offer proceeds.

Table 3.5 provides a summary data of Neuer Markt's Greenshoe offer proceeds as well as mean and scaled mean Greenshoe offer proceeds. Out of 252 new IPOs 187 IPOs offered Greenshoe reserve (74%) and 182 IPOs (72%) executed it. The proportion of offering and executions of Greenshoe reserve was much higher on Neuer Markt than on the 1st segment, 97% to 3% respectively, however, means are very close to one another. The null-hypothesis of equal medians for Greenshoe offers must be accepted at the 3.6 % level, stating that future strategies are very similar in both market segments.

3.3.2 The Listing Decision

Following Corwin and Harris (2001) we use for our investigation of the initial listing decision of IPOs the so-called dichotomous probit model[29] (see Aldrich and Nelson [1984]), which takes the form of:

$$\text{Prob}(1^{st}\text{ segment} = 1) = \phi(\beta' X_i)$$

Where $\phi(.)$ stands for the standard normal density $= (2\pi)^{-1/2}\exp\{-1/2((\beta' X_i)^2)\}$

β is a vector of coefficients,

and X_i is a vector of explanatory variables, i.e., $X_i = X_{1i}, X_{2i}, \ldots X_{ji}$,

the dummy regressand (the dependent variable) is 1 if the IPO listed on the FSE's 1st segment and 0 if listed on the Neuer Markt but met the FSE's 1st segment initial listing requirements. Qualitative and quantitative explanatory variables are included to identify market value, firm age, market-to-book, Greenshoe offers, listing fee differences, and a dummy on international dual listing[30]. A technology firm dummy variable and an industry dummy variable are included as well.

Explanation of dummy regressands:

$Y_i = 1$, if the IPO listed on the FSE's 1st segment

$Y_i = 0$, if the IPO listed on the NM but met FSE's 1st segment initial listing requirements

Explanation of regressors:

---

[29] The Probit model is also known as the Normit model, substituting the normal CDF in place of the logistic CDF as done for the Logit model. These models have been developed as alternatives to the LPM (Linear Probability Model), i.e., employing OLS for an estimation equation whose regressand is a quantitative variable, assuming the value 1 or 0. Due to severe problems in using LPM such as heteroscedastic variances of the disturbances, questionable value of measure of goodness of fit, or non-normality of disturbances, etc., and very advanced software packages, this method is rarely used, see Gujarati (1995), Kramer (1991) and Maddala (1983).

[30] Corwin and Harris (2001) define LOBs and carveouts, if a firm or a parent firm was previously listed on the 1st segment. Such data was not available, but data about an dual international listing, which is used instead.

INPT	Intercept
Ln of Market value	Logarithm of shares outstanding after the offer multiplied by the offer price
Market-to-Book	Market value of equity, plus book value of debt[31], divided by total assets[32]
Firm Age	Number of years from incorporation date to the IPO
Greenshoe proceeds	A reserve of shares for the first issuing date
Listing Fee Difference	Difference in first year percentage listing fees between the 1st Segment and the Neuer Markt Segment
DIL	Dual International Listing
Technology Firm	1 if the firm is in the technology's industry, 0 otherwise
Industry Dummy Variable	1 if the firm is in the industrial sector[33], 0 otherwise

Table 3.6 below displays the values of the coefficients, the standard errors, the t-values, and the p-values in brackets. The sample includes 252 firm-commitment IPOs between March 1997 (the year in which the Neuer Markt segment was established) and December 2001. IPOs either listed on the 1st segment, or met the 1st segment's initial listing requirements, but chose Neuer Markt. However, solely meeting the quantitative requirements does not guarantee a firm's listing on the 1st segment. Factors like a company's position and stability in its business segment, composition of Board of Directors, audit committee and voting rights as well as the requirement that the underwriter certifies that the IPO will meet share ownership and distribution standards are not taken into consideration due to data limitations. However, it can be assumed that these factors affect only a small number of IPOs as under normal circumstances firms

[31] Book value of debt consists of short term liabilities such as short-term loans, short-term share payable of long-term bonds, trade accounts payable, liabilities of income taxes, other short-term liabilities, etc., and long-term liabilities.

[32] Total assets consist of current assets, such as liquid funds, trade accounts receivable, inventory, deferred charges and prepaid expenses, deferred tax assets, and, intangible assets (e.g., licenses and patents), accumulated depreciation, and other assets. All figures taken out of balance sheet in the year previous to the issuing event.

[33] We identify industry as a technical manufacturing and/or producing entity. Panel B of table 3.6 down below shows the firms by industry. Consumers, Financial Services, Media, and Transport is to be considered as being 0 in the industry dummy variable defined above.

meeting the quantitative listing requirements are the major mile stones to get listed on 1^{st} segment.

Table 3.6: Results of the Probit Model$^{\otimes}$

3.6.1 Panel A: Different Specifications of the LSE (London-School-of-Economics)-Approach$^{\forall}$

Regressand, **1 = 1^{st} 0 = NM**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Intercept	-60.03 {26.6601} [-2.2517] (.025)	-36.248 {14.2296} [-2.5474] (.011)	-36.3900 {13.1529} [-2.7667] (.006)	-35.714 {12.9734} [-2.753] (.006)	-29.8602 {10.4986} [-2.844] (.005)	-18.2460 {4.4640} [-4.087] (.000)	-18.2458 {4.4649} [-4.0865] (.000)	-16.247 {3.689} [-4.403] (.000)
Ln (Market Value)	3.2889 {1.5205} [2.1630] (.032)	1.779 {.67967} [2.6188] (.009)	1.9102 {.74198} [2.5745] (.011)	1.8740 {.7316} [2.5614] (.011)	1.4819 {.55714} [2.6559] (.008)	.84691 {.22956} [3.6894] (.000)	.84715 {.22967} [3.6886] (.000)	.77639 {.1963} [3.9551] (.000)
Firm Age	.046892 {.020425} [2.2958] (.023)	.030775 {.017127} [1.7968] (.074)	.027968 {.014420} [1.9396] (.054)	.030739 {.014427} [2.1307] (.034)	.031876 {.013853} [2.3010] (.022)	.029317 {.011578} [2.5322] (.012)	.029255 {.011557} [2.5314] (.012)	-
Market-to-Book	-.018449 {.040918} [-.45087] (.652)	.2660E-3 {.0033572} [.079245] (.937)	.2904E-3 {.003969} [.073149] (.942)	.24E-3 {.004326} [.055491] (.956)	.4391E-3 {.002529} [.17419] (.862)	.2666E-3 {.001938} [.13755] (.891)	-	-
Greenshoe Offer Proceeds	-.6480E-7 {.424E-7} [-1.5296] (.127)	-.1698E-7 {.2003E-7} [-.84764] (.397)	-.1864E- {.212E-7} [-.87813] (.381)	-.189E-7 {.214E-7} [-.88104] (.379)	-.1339E-7 {.122E-7} [-1.1006] (.272)	-	-	-
Listing Fee Difference	-1.6190 {1.72} [-.94126] (.348)	-1.1845 {1.1149} [-1.0624] (.289)	-1.2855 {1.1364} [-1.1312] (.259)	-1.2462 {1.1253} [-1.1074] (.269)	-	-	-	-
DIL (Dummy)	2.2420 {1.4639} [1.5314] (.127)	1.0121 {92228} [1.0974] (.274)	1.0848 {.085697} [1.2659] (.207)	-	-	-	-	-
Technology Firm (Dummy)	-	2.2128 {5.3861} [.41083] (.682)	-	-	-	-	-	-
Industry Dummy (Dummy)	-2.5350 {1.4123} [-1.7949] (.074)	-	-	-	-	-	-	-
N	252	252	252	252	252	252	252	252
Iterations used*	16	14	14	14	12	10	10	9
Pseudo-R^2**	.73782	.66024	.64091	.61921	.58095	.51536	.51518	.39790
Goodness of fit***	.99203	.99203	.99203	.98805	.98406	.98008	.98008	.97610
Pesaran-Timmermann test****	12.9090 (.000)	12.9090 (.000)	12.9090 (.000)	11.1570 (.000)	9.0913 (.000)	7.3469 (.000)	7.3469 (.000)	4.4343 (.000)

Brackets represent {standard errors}, [t-values] and (p-values)

⊗ Positive (negative) signs of the regressors' coefficients indicate that higher values of the variables increase (decrease) the probability that an initial listing decision in favour of the first market segment (Neuer Markt segment) has been made (see Gujarati [1995], p. 570).

∀ This approach of model selection is also known as the Hendry, top-down or general to specific approach. The idea is easy but straightforward, we start with several regressors and whittle it down to a model containing only important variables (see Hendry and Richard [1983]).

* Estimators are generated by using an iterative procedure and converged after the mentioned number of iterations, using MLE (maximum likelihood estimation) procedure because Probit likelihood equations are non-linear in parameters, i.e., algebraic solutions are not obtainable. Approximations by standard iterative algorithms are used (e.g., "Newton-Raphson). Starting from an initial guess of the value of the coefficient a solution algorithm determines the size of a change. The coefficients are changed by this amount and the iterative process repeats again until no further change will produce an increase in the likelihood. The estimates of the parameters obtained from the probit model are roughly a factor $\pi/\sqrt{3}$ smaller than those obtained from a logit model, as the logistic distribution function has a variance of $\pi^2/\sqrt{3}$, acknowledging small differences in the shape of the distributions.

** Pseudo-R^2 is calculated as $1-(1/(1+2(\log L_1 - \log L_0)7N))$

*** "The goodness of fit measures the proportion of observations with correctly predicted (fitted) values ^y of y" see Pesaran & Pesaran (1997). Due to a very limited number of 1st segment IPOs, single values were investigated and found, that 5 out of 7 1st segment IPOs were predicted correctly. This number did not change in using the top-down approach.

**** The null hypothesis states that y_t and x_t are distributed independently, where y_t stands for the regressand and x_t for the regressors, i.e., x_t has no power in prediction of y_t. Fortunately, we can reject the null hypothesis at a 0 % level, stating that x_t has absolute power in prediction of y_t.

Table 3.6 displays all results of all specifications used for the analysis. Pseudo-R^2 ranges from almost 74 % to 40 % through all specifications and appears to be acceptably and reasonably high enough. The measures of goodness of fit have very high values through all specifications ranging from 98 % to 99 %.

The coefficient of market value is positive and remarkably significant in specification 1 but highly significant through specifications 2 to 6. This suggests that smaller and riskier firms prefer to list on Neuer Markt segment[34]. Market-to-Book coefficients are positive through specifications 2 to 6, suggesting that the de-listing costs hypothesis is not important for IPOs. Only in specification 1 it seems to be important. However, it is not significant in any specification. Firm Age coefficients are positive through all specifications, and are significant in specifications 2 and 3, where the p-value exceeds the commonly used 5 % level, and highly significant in specifications 1 and 4 to 7 with p-values below the 5 % level, giving evidence that younger firms are more likely to list on Neuer Markt segment and that market maker sponsorship is an important factor in the listing decisions of IPOs. This finding is consistent with the predictions of Aggarwal and Angel (1997) that firms prefer a "... dealer market if benefits in reduced cost of capital from greater exposure in the dealer

[34] The reason behind that argument is that a positive and significant value of a coefficient supports the regressand dummy with value 1 and vice versa (see Gujarati [1995]).

market are greater than the benefits of reduced bid-ask spread in the auction market less annualised maintenance fees." See Aggarwal and Angel, op.cit., p. 18 f.

Coefficients of Greenshoe Offer Proceeds, Listing Fee Difference, Dual International Listing, and Technology Firm are insignificant through all specifications, suggesting that these variables do not play an important role in the listing decision of companies. Only the Industry Dummy variable is weakly significant with a p-value of (.074), suggesting that IPO listings weakly cluster by industry.

3.6.2 Panel B: Calculations of Marginal Effects

Regressand, 1 = 1st 0 =NM	1	2	3	4	5	6	7	8
Factor *	.5396E-8	.1893E-3	.5051E-3	.6569E-3	.0011149	.0062180	.0061910	.014756
LNMV	.177473E-8	.3369E-3	.0096484	.0123103	.00165217	.00526609	.00524470	.011456
MTB	-.99551E-11	.50354E-7	.1467E-6	.1577E-6	.48955E-7	.16577E-6	.1811E-4	-
AGE	.253029E-10	.58257E-6	.141266E-4	.2019E-3	.35531E-6	.18229E-4	-	-
GREENSHOE	.349961E-15	-.321E-11	-9.412E-11	.124E-10	-.149E-11	-	-	-
LFD	-.626961E-9	-.0022423	-.00649306	-.0081863	-	-	-	-
IDL	.120978E-8	.00191591	.005479325	-	-	-	-	-
TECHNO	-	.00418883	-	-	-	-	-	-
INDUSTRY	-.136789E-8	-	-	-	-	-	-	-

* To estimate the marginal effect of a unit change in a variable the above mentioned factor for the calculation of marginal effects must be multiplied by the estimated coefficient of the variable, technically: $\partial Pr(1^{st} segment_i = 1)/\partial x_{ij} = \beta_j \phi(\beta' x_i)$ for j = 1, ... , k and i = 1, ..., n where $\phi(\beta' x_i)$ stands for the standard normal density function, in other words, one needs to evaluate the appropriate density functions at the relevant points and multiply the values by the coefficient estimates associated with the appropriate variables (see Borooah [2002], p. 31).

The marginal effects of a unit change through all of specification 1 is very small and not worth interpreting it. In specification 2, however, other things being constant, the Market Value being increased by 1 %, the probability of an IPO going public at the 1st market segment would increase by 0.0003 %, pointing out the correctness of IPOs with a very high market value join the 1st Market Segment. Increasing the listing fee difference by 1 % would decrease the probability of IPOs joining the first segment by 0.002 %, or, in other words, increase the probability of joining Neuer Markt segment by 0.002 %, ceteris paribus. Holding all other things constant, the probability of IPOs joining the 1st segment is 0.002 % higher, if they are internationally dually listed, other things remaining constant, and the probability of joining the 1st market is 0.004 % higher, if the IPO is defined as a technology firm, holding other things unchanged. As the coefficients of the listing fee difference and the dummy variables are statistically not significant, we can say that these variables do not influence the listing decision of IPOs considerably. However, an IPO being defined as a technology firm and being internationally dually listed, increasing its market value and the listing fee difference by 1 %, the probability of joining the 1st market segment is increased by 0.004 %, all other things remaining the same.

In specification 3, by increasing the market value by 1 %, the probability of IPOs joining the 1st segment increases by 0.001 %, other things constant. The listing fee difference being increased by 1 % increases the probability of IPOs joining the Neuer Markt segment by 0.006 % (and, of course, decreases the probability of joining the 1st segment by the same amount), other things constant. Being internationally dually listed increases the probability of joining the 1st market segment by 0.005 %, ceteris paribus. However, the listing fee difference and the dummy of dual international listing are statistically not significant, and thus, do not influence the decisions of firms going public. Finally, being internationally dually listed and increasing the market value and the listing fee difference by 1 %, the probability of joining Frankfurt's 1st segment is being increased by 0.009 %, ceteris paribus.

The results of specification 4 show, that increasing the market value by 1 % increases the probability of IPOs listing on the 1st segment by 0.0123 %, other things unchanged. Being 1 year longer incorporated increases the probability of joining the 1st market by 0.0002 %, ceteris paribus. Increasing the listing fee difference by 1 %, the probability of IPOs joining the first market segment increases by 0.008 %, other things remaining constant. The listing fee difference is statistically not significant, suggesting that this does not influence the decision of IPOs. Nevertheless, increasing the market value and the listing fee difference by 1 %, the probability of joining the 1st market segment increases by 0.004 %, other things being unchanged.

Increasing the market value by 1 % in specification 5 raises the probability of IPOs joining the 1st market segment by 0.0016 %, ceteris paribus, while in specification 6 and 7, under the same conditions, it raises the probability by 0.005 %, respectively, other things remaining the same. Finally, in specification 8, increasing the market value by 1 %, the probability of IPOs joining the 1st market segment raises by 0.0115 %, other things remaining constant.

3.4 Conclusion

On March 10, 1997 the Neuer Markt Segment was launched as a trading segment for small and medium-sized companies with outstanding growth prospects. Those companies are mainly from the High-tech sector but also from traditional sectors (see table 3.4). The purpose was to enable risk tolerant private and institutional investors to benefit from new investment opportunities. In order to make it more attractive to international investors and to improve investors' confidence IPOs must publish their annual reports in English and German, following IAS and US-GAAP.

The examined sample of 252 IPOs either listed on the 1st segment or on the Neuer Markt segment, but met the 1st segment's listing requirements (and vice versa). Of these IPOs only 2 % listed on the 1st segment, while 98 % of the sample size listed on the Neuer Markt segment, suggesting that IPOs prefer the dealer market and they are also directed into this segment by the Frankfurt Stock Exchange itself.

Probit results show that smaller and riskier firms tend to list on the Neuer Markt segment. This finding is consistent with the avoidance of expected de-listing costs hypothesis modelled by Foucault and Parlour (2001). Moreover, we find that younger firms are more likely to list on the Neuer Markt segment, which provides strong support for the market sponsorship hypothesis of Aggarwal and Angel (1997). Of the remaining coefficients only the Industry Dummy Variable is significant at a sufficient level. This gives some evidence that IPO listings weakly cluster by industry. Follow on strategies (Greenshoe), listing fee differences, existing listings on other international stock exchanges do not appear to play an important role in the initial listing decision.

Our findings highlight that the creation of the Neuer Markt segment was not to create a competitor for the 1st market segment but to create a market maker sponsorship segment to give young and unknown companies the opportunity to raise capital on the Frankfurt Stock Exchange. This is another step of the German Financial Market towards the international practice of raising capital via stock exchanges, away from the traditional bank financing attitude of German companies. A milestone in this evolution is also the requirement of issuing quarterly and annual reports not only consistent with the German Trade Code (HGB) and German Accounting Principles (GOB) but also satisfying US-GAAP and IAS requirements. These changes will play a significant role in the future international recognition of the German Financial Market.

The major differences in this investigation to the investigation of the US-market conducted by Corwin and Harris (2001) is that the German financial market is less developed compared to the US-market as outlined in this paper. The short existence of the Neuer Markt segment and the limited data set, as well as different follow-on strategies lead to different or not always comparable conclusions. However, the attractiveness of the Neuer Markt has dramatically declined, both for investors and for fund seeking companies, due to the Stock Market crash of 2000/2001 mentioned in the introductory section. This is underlined by the fact that from January 2002 to the end of August 2002 only two companies went public.

Annexes

Annexe 1: 3.7 Rating of Designated Sponsors

Name of Designated Sponsor	Rating	Assigned Rank*
ABN Amro Bank (Deutschland) AG	AA	9
Baader Wertpapierhaus AG	AA	9
Baden-Wuerttembergische Bank AG	AA	9
Bankgesellschaft Berlin Ag	AA	9
Bayer, Hypo- und Vereinsbank AG	AA	9
Bayerische Landesbank GZ	AA	9
BHF Bank AG	AA	9
BNP Paribas S.A.	AA	9
Commerzbank AG	AA	9
Concord Effekten AG	AA	9
Consors Capital Bank AG	AA	9
Credit Suisse First Boston (Europe) Ltd.	AA	9
Deutsche Bank AG	AA	9
Deutsch Postbank AG	AA	9
DG Bank DT. Genossenschaftsbank AG	AA	9
Dresdner Bank AG	AA	9
Goldman Sachs & Co. OHG	AA	9
Gontard & Metallbank AG	AA	9
GZ Bank AG	AA	9
Hamburgische Landesbank AG	AA	9
Hauck & Aufhaeuser KGAA.	AA	9
HSBC Trinaus & Burkhardt KGAA	AA	9
ICF Intermediaer Center Frankfurt	AA	9
IKB Deutsche Industriebank AG	AA	9
J.P. Morgan Securities Ltd.	AA	9
Joh. Berenberg, Gosller & Co.	AA	9
Landesbank Baden-Wuerttemberg	AA	9
Landesbank Hessen-Thueringen GZ	AA	9
Landesbank Rheinland-Pfalz GZ	AA	9
Landesbank Sachsen Girozentrale	AA	9
Lang & Schwarz Financial Services GmbH	AA	9
Lappe & Partner AG	AA	9
Lehman Brothers Int. (Europe)	AA	9
M.M. Warburg & Co	AA	9
Merrill Lynch Capital Markets Bank Ltd.	AA	9
Morgan Stanley Bank AG	AA	9
Norddeutsche Landesbank GZ	AA	9
Peter Koch Xchange Brokers GmbH	AA	9
Raiffeisen Zentralbank Oesterreich AG	AA	9
Robertson Stevens Int. Ltd.	AA	9
S&Z Boersenmakler GmbH	AA	9
Salomon Brothers AG	AA	9
Schmidtbank KGAA	AA	9
Stadtsparkasse Koeln	AA	9

Vereins und Westbank AG	AA	9
Westdeutsche Gen. Zentralbank GZ	AA	9
Westdeutsche Landesbank GZ	AA	9
Wolfganf Steubing AG	AA	9
Bankhaus Merck, Finck & Co	AB	8
Bank J. Vontobel & Co. AG	AC	7
SG Securities (London) Ltd.	AC	7
Equinet Securities AG	AD	6
German Brokers AG	AD	6
MWB Wertpapierhandelshaus	BA	5
Sal. Oppenheim Jr. & Cie. KGAA	BA	5
Kling Jelko Wertpapierhandelsbank AG	BC	4
ICE Securities Ltd.	DD	3
Berliner Freiverkehr Atien Handel AG	None	1
Frohne & Klein Wertpapierhandelshaus AG	None	1
Gebhard & Schuster Wertpapierhandesbank	None	1
Trigon Wertpapierhandelsbank	None	1
UBS Warburg AG	None	1
Archelon Deutschland GmbH	None	1

Source: Xetra Special Deutsche Boerse October 2001
* = the following rating obtains the following assigned rank: AA = 9, AB = 8, AC = 7, AD = 6, BA = 5, BC = 4, DD = 3, None = 1. A rank of 9 represents the most prestigious designated sponsor in the sample (see also Carter and Manaster [1990])

The Rating Concept

"The average quoting time, the average spread and a designated sponsor's trading volume are part of the rating. The quoting time is the period in which the designated sponsor offers liquidity. The average spread is weighted and describes the %age spread between a designated sponsor's offer on the buyer's and the seller's side. A bonus for quoting time and spread is attained by regarding the volume achieved within the framework of a designated sponsor's activities.

Before granting a rating, the set minimum requirements for a designated sponsor regarding the answering of quote requests and the participation in the auctions of at least 90% or the shares the designated sponsor is registered for must always be met." See Rating for Designated Sponsors, Special Xetra Deutsche Boerse, October 2001 page 5

Chapter four: The Costs of Going Public in the German Financial Market

4.1 Introduction

Since the introduction of the Neuer Markt Segment in March 1997, more companies went public in the German Financial Market than ever before. Historical evidence suggests that German companies finance investment projects mainly by raising capital through the banking system. The new trend of raising money through Stock Exchanges by issuing stocks is due to the increased efforts of the Management of the FSE (Frankfurt Stock Exchange) to make more young companies known to the public (see Ihr Boersengang Leitfaden fuer Emittenten zu Going Public and Being Public, September 2001, pp. 2 - 5).

This paper analyses the costs of the Market Segment choice decision of IPOs (initial public offerings). It is an event-time study of the costs of going public in the German Financial Market in either the 1st Market Segment, the Neuer Markt Segment, or the SMAX Segment of the Frankfurt Stock Exchange from March 1997 to December 2001. Circumstances will be discussed under which each of these strategies, 1st Market Segment, Neuer Markt Segment, or SMAX segment is optimal for the IPOs. The period chosen spans the introduction of the Neuer Markt Segment in the German Financial Market. The pre-Neuer Markt Segment period was not taken into consideration due to 2 reasons, viz., the trend of going public started with the mentioned introduction and data before that period is not interesting due to a very limited number of IPOs.

Cross-sectional data for all 362 IPOs in the investigated period was available. The costs under consideration could be down-loaded from the Homepage of the Neuer Markt, NeuerMarkt.com, i.e., annual statements, balance sheets and profit and loss accounts. Unfortunately, data for so-called Other Expenses such as listing and registration fees, as well as costs for Road Shows, Auditing Fees, Expenses for Issuing Prospectuses, etc., were not available.

This paper contributes to the literature by constructing unique data sets for the empirical investigation of the costs of going public in the German Financial Market, which have not been used in any research so far. Quantitative and Qualitative variables are used take account of particular German circumstances. The relatively short existence of the Neuer Markt Segment which was founded in March 1997 and modelled on Nasdaq makes this investigation so interesting as conclusions of the developing German Financial Market can be compared with the conclusions derived by Corwin and Harris (2001) who investigated the highly developed US Financial Market.

This paper is organised that in section 1.1 there is an extensive literature survey conducted and in section 1.2 the characteristics of the German Financial Market are discussed. In section 2 the model of Foucault and Parlour (2001) is partially outlined and in section 3 the statistical and econometric investigation is conducted. Section 4 summarises and concludes.

4.1.1 Literature Review

Ritter (1987) investigates the costs of going public. Two quantifiable components of these costs are investigated: direct expenses and Underpricing. He finds that these costs average 21.22 % of the realised Market Value of issued shares for firm commitment offer contracts (where IPO and investment banker hold a pricing meeting at which offer price and number of shares are agreed upon) and 31.87 % for best efforts offer contracts (where investment bankers agree on an offer price and a minimum and maximum number of shares to be sold). Ritter concludes that small and more speculative firms raise capital by using best efforts offer contracts[35] while more established firms tend to raise money through commitment contracts[36]. Moreover, Ritter (1984) and Beatty and Ritter (1986) show that average firm commitment offers raise almost four times as much money as average firms using best efforts offer contracts. Mandelker and Raviv (1977) argue that in best efforts offer contracts the issuing firm

[35] In a best efforts contract, the IPO and its investment banker agree on an offer price and a minimum and maximum number of shares to be sold. Then, the investment banker makes its "best efforts" to sell the shares to private and institutional investors. Investors can indicate special interest by depositing money in an escrow account established by the underwriter. If the minimum number of shares is not sold at the offer price during the specified period, the offer is withdrawn, the investor is refunded and the IPO receives no money.

[36] The IPO and the investment banker hold a pricing meeting at which the offer price and number of shares to be sold are agreed upon. Then, the investment banker guarantees to deliver the proceeds net of commission to the IPO, whether or not the offer is fully subscribed at the offer price. Once an offer price is set, shares cannot be sold at a higher price.

assumes the proceeds risk and in firm commitment offer contracts it is borne by the investment banker (see also Barclay, Kandel and Schultz [1986]). They define risk as the uncertainty of the amount of money that can be raised.

Madhavan (1992) investigates price formation under two trading mechanisms, viz., a quote and an order driven system. In the quote driven system dealers post prices before order submission and in the order-driven system traders submit orders before prices are determined. The order driven system distinguishes between continuous auction, where orders are executed immediately, and periodic auction, where orders are stored for simultaneous execution. He concludes that the advantage of the periodic system is greater price efficiency while traders in this system must sacrifice continuity and accept higher information costs.

Carter and Manaster (1990) investigate returns earned by subscribing to IPOs. They show that the more the investors are informed the higher the required returns will be. They come to the conclusion that the underwriter's reputation reveals the expected level of informed activity. The higher the underwriter's reputation, the lower are risk offerings. Less risk means less incentive to acquire information for fewer informed investors. Hence, prestigious underwriters are associated with IPOs that have lower returns. Rock (1986) comes to a different conclusion, viz., that IPO returns are required by investors who are poorly informed as a compensation for the risk of trading against superior information.

Affleck-Graves, Hegde, Miller and Reilly (1993) investigate the effect of the trading system on the Underpricing of IPOs. They conduct an empirical analysis and investigate differences of the NYSE, AMEX, and the Nasdaq from January 1983 through December 1987. They find that on the average, NYSE IPOs are underpriced by 4.82 %, AMEX IPOs by 2.16 %, and Nasdaq IPOs by 5.56 % and 10.41 %, for Nasdaq/NMS and Nasdaq/non-NMS, respectively, where NMS stands for National Market System. They propose that the higher the listing standards are the more reduced is the uncertainty about the value of an IPO and the more reduced is expected Underpricing (see also Lee, Lochhead, Ritter, and Zhao [1996], who examined for direct issue costs, consisting of Underwriter-Spread and other direct issue costs, and Underpricing).

Carter, Dark and Singh (1998) investigate underwriter reputation, initial returns and long-run performance of IPOs. They find that under-performance of IPO shares investigated over a three years period is less severe if handled by higher quality underwriters. Hence, even if involved with higher costs they conclude that IPOs should use high reputation underwriters in order to avoid higher cots in the long-run. Christie and Schultz (1994), and Christie, Harris and Schultz (1994) investigated whether IPOs were affected by reports of implicit collusion among market makers but found no evidence that decisions changed after these reports were published. However, Beatty and Welch (1996) find a positive relation between underwriter quality and issue costs in the 1990s.

Megginson and Weiss (1991) investigate the costs of IPOs which are backed by venture capital. They investigate IPOs during a period of 1983 through 1987 and find that the presence of venture capitalists serves to cut off costs of going public and maximise net proceeds to the offering firm. They document that in the US venture capitalists retain a significant portion of shares after the IPO and certify the quality of the issue through their investment.

Sanger and Peterson (1990) report an empirical analysis of firms' delisting from major stock exchanges and the implicit negative impact of the firms' value. Firstly, they describe the delisting process and then, secondly, the stock price movements surrounding delisting. Equity values of firms with prior announcements decline by about 8.5 percent at that very day. For firms without prior announcements, a similar adjustment takes place over the subsequent non-trading interval. However, they conclude that returns following delistings appear to be consistent with market efficiency. Sanger and McConnell (1986) investigate the listing and delisting costs of the pre- and post-Nasdaq period (see also Clyde, Schultz and Zaman [1996]). They conclude the abnormal positive and negative returns in respond to listing announcements in the pre- and post-Nasdaq period. However, in the post-Nasdaq period firms earn significant negative returns immediately after listing. This finding is consistent with their hypothesis that Nasdaq had reduced benefits associated with listings on main stock exchanges.

4.1.2 The Characteristics of the German Financial Market

In Germany, the Stock Markets can be seen as being underdeveloped as a method for raising money and financing corporations. However, the 1996 floatation of Deutsche Telekom, with its record of 20.9 billion DM value of issued shares showed that more and more sectors of the population are interested in shares (see annual report Deutsche Telekom 1997).

Roughly about 500,000 corporations hold the German legal status of a limited-liability company, GmbH (Gesellschaft mit beschraenkter Haftung), while only about 4,600 corporations have the status of a joint-stock corporation, AG (Aktiengesellschaft), and by the end of the year 1998 only 741 were officially listed. Estimates of experts show that there are roughly 2,000 firms which qualify as IPO (see Information Folder Deutsche Börse).

One of the major problems so far that prevented foreign companies to go public in Germany or foreign investors to buy shares on German Stock Exchanges were the legal and economic disclosure requirements referring to German Accounting Principles GOB (Grundsaetze ordnungsgemaesser Buchfuehrung) and the German Trade Code HGB (Handelsgesetzbuch), which are quite different from international standards.

However, more and more investors cross borders to buy international stocks. Institutional investors invest globally and try to optimise profits and returns at optimised risk spreading. Hence, investors are forced to analyse markets and companies on a global scale. These global investments are based on considerations based on the market portfolio theory, allowing to diversify risk across a number of economies (see Francis [1993]).

In order to survive this international competition, the Frankfurt Stock Exchange has implemented international standardisation requirements for German IPOs, satisfying transparency and information needs for investors. Financial statements have to be prepared according to the US-GAAP (United States - Generally Accepted Accounting Principles), which have established themselves in the international capital market. The reason being that many young and high growth capacity companies are located in the US or are listed on an US Stock Exchange. Hence, IPOs applying US-GAAP can thus be easily compared to international competitors.

Finally, stock holders call for company figures that reveal the actual financial situation on the basis of a straight and open policy. Understanding this need is one of the highest hurdles the participants in the German Financial Market have to overcome.

The number of growth oriented and innovative companies in Germany are increasing rapidly. Globalisation of markets, shorter product cycles, increasing costs for research and development and for marketing, etc. forces even small- and medium sized companies to look for new ways of raising capital. These companies try to move away from the traditional German banking based financing of investment projects and raise capital through the Stock Market (see Neuer Markt Information Folder, 2001-01-01).

4.2 The Model

In the following, the theoretical 5 period model of Foucault and Parlour (2001) is described and used to investigate the costs of going public in the German Financial Market. In this model exchanges compete for IPO listings and it is predicted that " ... a low trading cost exchange should charge larger listing fees than a high trading cost exchange." (see Foucault and Parlour op.cit., p. 5). This prediction is confirmed by the finding of table 4.1: Issue Costs Statistics; where single issue costs are lower on 1st Market Segment than on Neuer Markt Segment. However, listing fees can be considerably higher on 1st Market Segment than on Neuer Markt Segment (see appendix 1).

Foucault and Parlour, op. cit., describe an economy with three classes of agents being considered: entrepreneurs, investors and exchanges.

Entrepreneurs: They are risk neutral and endowed with a constant returns to scale technology, x, which differs across them and is known to potential investors, where $x \in [x_v, x^k]$, and v stands for floor and k for cap. Now, an entrepreneur invests I dollars at date 3, generating a gross cash flow of I(1+x) at date 5. Each entrepreneur's utility function is given by:

$$U_e = \Sigma\, c_t \qquad (1)$$

where t = 3, 4, 5 and c_t is the entrepreneurs consumption at date t. Entrepreneurs wealth is zero, hence they must raise money for investment projects by issuing shares. These shares are devisable and each share is normalised to $1. The dividend paid at date 4 is zero and at date 5 is (1+r). It is focused exclusively on the choice of a listing location and not on the choice of going public or not. At date 3, each entrepreneur chooses a listing location, an issue size, I(x), and the promised rate of return to maximise his utility.

Investors: They can either privately store money at a zero rate of return or invest in shares issued by entrepreneurs. Each investor may need to consume (i.e., is hit by a liquidity shock with probability s at date 4) at date 4 or date 5. The utility function is expressed by:

$$EU_s = c_3 + sEc_4 + (1 - s)Ec_5 \quad (2)$$

Where large (small) s stand for short term (long term) investors. An investor who is hit by a liquidity shock liquidates his portfolio, i.e., he sells his shares to a trader as the wealth of the IPO at date 4 is zero. The per share trading cost at exchange j is c_j.

Exchanges: There are two exchanges, where c_j represents the trading costs per share (these costs are measured by the bid-ask spread) and F_j the listing costs, which might be negative in the case of a subsidy. At date 1 the exchanges simultaneously choose their trading technologies, i.e., their specific set of trading rules. Moreover, q_j is the inverse of the trading cost level ($q_j = 1/c_j$) which stands for the quality of exchange j. Then, at date 2 the exchanges simultaneously set their listing fees, F_j, that must be paid by any firm if going public on one of the exchanges. Further, the per share trading cost of exchange j can be decomposed as follows:

$$c_j = c^F{}_j + c^I_j$$

Where $c^F_j \geq 0$ and $c^I_j \geq 0$ are the trading fees and implicit trading costs, respectively and both components are under the control of the exchange.

The objective function of the exchange is derived the following way. The subset of entrepreneurs listing on exchange j is $\chi_j \subseteq [x_f, x^c]$. The expected trading volume is technically expressed as Vol(x, c_j) for shares issued by an entrepreneur of type x. Marginal cost of an additional listing is normalised to zero. Hence, the function is:

$$\Pi_j(\chi_j) = F_j \Pr[x \in \chi_j] + [c^F_j + c^I_j]E[Vol(x, c_j) \mid x \in \chi_j].$$

or since $c_j = c^F_j + c^I_j$

$$\Pi_j(\chi_j) = F_j \Pr[x \in \chi_j] + c_j E[Vol(x, c_j) \mid x \in \chi_j] \qquad (3)$$

where the first component is the revenue from listings and the second from trading.

As a next step, in the paper of Foucault and Parlour (2001) the model is further developed for the initial public offering process, competition for listings and the choice of trading technologies. They further develop their model for short term competition in listing fees and long term competition in trading technologies (see also Ritter [1991]). Finally, they test for robustness in their section 3.3. As a first step, they check for the number of exchanges by using the so-called "finiteness property" (see Shaked and Sutton [1982] and [1983]), where "... the number of firms that can profitably enter the market is bounded, no matter how small the cost of entry." (see Foucault and Parlour [2001]; p. 21). Then, they check for multi-market trading. In other words, they assume that investors must trade securities on the exchange where they are listed. Moreover, the exchange does not have the right to trade the shares of firms that are listed on that exchange. They conclude this subsection by stating that in equilibrium, exchanges differentiate their trading technologies, if the range of trading costs is sufficiently large, which is already stated in their proposition 4, page 20:

Proposition 4: If $\Sigma > 5/2$ and $((c^c - c_f)/c_f) > 1/4$ then in any equilibrium in pure strategies one exchange chooses the trading technology with the low trading costs c_f and one exchange chooses the trading technology with the high trading costs c^c. In this case listing fees and profits are given by proposition 1.

Where Σ is a measure of an entrepreneur's heterogeneity.

Finally, they investigate the timing of decisions. They assume, that exchanges first choose their quality (trading cost) and afterwards the price (listing fee).

Of most interest for the purpose of this paper is, however, their section 4, where the implications for IPOs and listing fees are investigated. It is stated that the characteristic of IPOs (issue size, proceeds, Market Value) on two exchanges charging different trading costs should differ in a systematic way. Hence, their corollary 3, which is of much interest for this paper, is reprinted (see Foucault and Parlour [2001], sections 4.1 and 4.2, pp. 26 - 28):

Corollary 3: In any economy in which two exchanges with different trading technologies compete for listings:

1. The proceeds of an IPO taking place on the low trading cost exchange are larger than for the high trading cost exchange, or
   $E[I(\xi) \mid \text{Lists on Exchange 1}] > E[I(\xi) \mid \text{Lists on Exchange 2}]$

2. The expected Market Value ('market capitalisation') of a firm listed on the low trading cost exchange is larger than for a firm listed on the high trading cost exchange, or
   $E[(1 + r(\xi))\, I(\xi) \mid \text{Lists on Exchange 1}] > E[(1 + r(\xi))\, I(\xi) \mid \text{Lists on Exchange 2}]$

As can be seen in the appendix 1, once the issued amount of shares exceeds Euro 80 million, the listing fee of the 1st Market Segment exceeds the listing fees charged by the Neuer Markt. This is in accordance with the finding of Aggarwal and Angel (1997) that firms will prefer the dealer market (Neuer Markt) if the benefits of the higher costs involved in that market is greater than the benefits gained from the high cost market (1st Market Segment). Firms known to the public will choose the low cost market Segment for their listing activities.

Corollary 4: Consider the equilibrium in which both exchanges co-exist with different trading technologies

1. An increase in the trading cost for the low trading cost exchange leads to a decrease in the listing fee on both exchanges.
2. An increase in the trading cost of the high trading cost exchange leads to an increase in the listing fees of both exchanges.
3. Furthermore, the differences in listing fees between the two exchanges is proportional to the trading cost differential

$$F^*_1 - F^*_2 = (m/7)((c_1 - c_2)/c_1c_2)$$

Where m is the mean of the distribution of types of entrepreneurs.

Foucault and Parlour (2001) provide a model of competition where exchanges decide for their trading technologies and listing fees. In choosing different trading technologies exchanges can relax competition for listings. Their model gives also an explanation to the diversity of trading technologies that are used by stock exchanges. Finally, they discuss IPO characteristic on different Stock Exchanges, listing fees and the desirability of self regulation by Stock Exchanges, which is of no further interest for the purpose of this paper.

4.3 Econometric Analysis

We investigate the costs of going public by the means of OLS using an ANCOVA (analysis of co-variance)- model, where quantitative and qualitative explanatory variables are used to analyse issue costs. Differences in such issues costs[37] are to be considered in addition to the listing criteria mentioned above. Hence, it must

[37] Under US-GAAP, certain expenses arising in the context of the issuance of shares can be recognised as a reduction of equity without influencing the profit and loss account. Under the German commercial code

be tested whether costs of going public differ across German Financial Market Segments under investigation.

In the following, we investigate the different cost components an IPO is confronted with, such as Underwriter-Spread, Other Expenses, Total Direct Costs, Underpricing and Total Issue Costs. Underwriter-Spread is the difference between offer price and price received by the issuer, i.e., the issuing Market Segment (see Amihud and Mendelson [1986]). Other Expenses consist of listing and registration fees (due to the deterministic nature of listing fees, Corwin and Harris [2001] re-estimate their regression excluding such fees and find, that differences in final costs are not limited to listing fees), legal and auditing fees, costs of preparing registration statements, issuing prospectus pursuant to Arts. 77, 45 following of the German Stock Exchange Act, presentations to make a company's efforts to go public known to private and institutional investors by awaking their interest in the securities to be traded, so-called "Road-Shows" (such as a stand in a fair, etc.), publications and notifications, quarterly and annual financial statements, the corporate calendar, which contains time and place of general meetings, accounts press conferences, analysts meetings to be held once a year, and so forth. Total Direct Costs are simply the sum of Underwriter-Spread and Other Expenses. Underpricing is the percentage price change from the offer price to the closing price on the first day of trading (for an extensive discussion of Underpricing see Affleck-Graves et. al. [1993]). Finally, Total Issue Costs is the sum of Total Direct Costs plus Underpricing. Following the investigation of Corwin and Harris (2001) we also state all costs as a percentage of the Market Value, which is defined as shares outstanding after the offer multiplied by the offer price, excluding Greenshoe, the reserve of shares in order to satisfy demand after the offer price is settled.

Connecting the theoretical model to the econometric one is straightforward. One observable variable that is plausibly related to proceeds of an IPO is covered by the variable Market Value, which is a synonymous for Offer Proceeds, represented by $E[I(\xi)]$. While F stands for listing and registration fees, which are the major parts of Other Expenses, c_j stands for the different cost components taken into consideration when going public, such as Underwriter-Spread, Underpricing and Total Issue Costs. Corwin and Harris (2001) show that listing and registration fees are deterministic cost

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these costs are expenses at the moment they arise. Fortunately, annual reports of all investigated IPOs are components and omitting them does not change the outcome of their research. The expected market capitalisation $E[(1 + r(\xi))\, I(\xi)]$ is represented by the Underwriter Market Share, which is a variable for the quality of the Underwriter in supporting an IPO in the publishing process. Preferences of IPOs between both Market Segments are covered by the qualitative variable 1^{st}. Further qualitative variables are included to define the IPO's characteristic, such as dual international listing and venture backed capital. The measure of an entrepreneur's heterogeneity Σ and the mean of the distribution of entrepreneurs m is being investigated by the means of parametric tests if the sample is likely to be normally distributed and by non-parametric tests if not.

Firstly, we start by analysing the characteristics of German IPOs under consideration, i.e., IPOs that fulfil requirements for both Market Segments. It was found that out of 362 IPOs 252 satisfied the requirements for both Segments in the investigated period.

Table 4.1 presents the univariate summary statistic of average gross proceeds, sales and book values for IPOs going public between March 1997 and December 2001 and fulfilling requirements for 1^{st} Market Segment and Neuer Markt Segment.

Table 4.1: Characteristics of German IPOs fulfilling Requirements for both Market Segments*

	All Offers	1^{st} Segment Offers	Neuer Markt Offers
IPOs	252	7	245
Average Total Assets in Euro	84,380,002	538,610,191	41,663,562
Average Book Value of Debts in Euro	47,150,904	238,125,296	71,401,996
Average Market Value in Euro	100,163,684	1,099,373,551	71,614,831
Average Years existing prior to IPO	15	33.7	14.3
Internationally Dually Listed	9 (100 %)	1 (11 %)	8 (89 %)
Backed by Venture Capital**	113 (100 %)	6 (5 %)	107 (95 %)

published as per US-GAAP and IAS. Hence, direct issue costs are defined as per US-GAAP.

* All financial data was taken from the annual statements, balance sheets and profit and loss accounts of the IPO from the year of the public going event.
** Backed by Venture Capital was defined as another company holding more than 17 % of the Equity Capital

The above given summary statistic gives a clear picture of the characteristics of German IPOs. Average total assets of IPOs joining the 1st Market Segment are exceeding these of Neuer Markt IPOs by far. Even if the average book value of debt is also much higher than the average book value of debt in the Neuer Markt Segment, it can be seen, that equity capital of IPOs in the Neuer Markt is much below equity capital of 1st Market Segment IPOs. This is a clear sign of the high risk nature of the Neuer Markt and the implication, that investors require a higher rate of return.

The average Market Value of 1st Market Segment IPOs is outstandingly exceeding the average Market Value of Neuer Markt IPOs, saying that mostly big and known companies are joining the 1st Market Segment. This theory is supported by the average number of years of IPOs existing prior to the publishing event. While 1st Market Segment IPOs exist on the average for 33.7 years prior to the public offering process, Neuer Markt IPOs are considered to be quite "young" with an average age of only 14.3 years prior to the event.

Neuer Markt IPOs are more often internationally dually listed, roughly 89 % of all IPOs are Neuer Markt IPOs, saying that a greater portion of young companies go public internationally. Finally it can be seen that more Neuer Markt IPOs are backed by venture capital (95 % in the Neuer Markt Segment).

As a next step, the univariate summary statistic of all cost components is presented:

Table 4.2: Issue Costs Statistics of IPOs fulfilling Requirements for both Segments

Variable (in %)	1st Segment IPOs	Neuer Markt IPOs	All IPOs	p-value*
N	7	245	252	-
Underwriter-Spread	3 %	13.96 %	13.6 %	(.122)
Other Expenses**	n.a. [0.38 %]	n.a. [2.4 %]	n.a. [2.34 %]	- [.003]
Total Direct Costs***	3 % [3.38 %]	13.96 % [16.36 %]	13.6 % [15.94 %]	- [.116]
Underpricing	0.38 %	0.4 %	0.4 %	(.826)
Total Issue Costs	**3.38 %** **[3.76 %]**	**14.36 %** **[16.76 %]**	**14.0 %** **[16.34 %]**	**(.536)** **[.500]**

Values in [ ] parenthesis show the results if deterministic listing fees (see annexe 1) as a percentage of the Market Value of the respective IPO are included in the investigation

* The Kolmogorov-Smirnov-test showed for all investigated data sets that exhibited p-values < 0.000, i.e., the population of both Market Segments are unlikely to be Gaussian. Then, a Wilcoxon-rank (or Mann-Whitney-U) test has been conducted with the software package "GraphPad Instad Version 3.00". We can accept the null-hypotheses of equal medians of data of 1st Market Segment and Neuer Markt Segment. In other words, on the average variables do not differ much in both Market Segments. This is consistent with the theory that the data was drawn from one population, viz., IPOs fulfilling requirements for both Market Segments. However, the p-value for Other Expenses is highly significant, saying, that the null-hypothesis of equal medians must be rejected at a very high level. In other words, deterministic costs differ significantly in both market segments, which is consistent with economic theory.

** Data on Other Expenses was not available = n.a., hence, Underwriter-Spread = Total Direct Costs. However, taking deterministic costs of annexe 1 into consideration, listing fees can easily be calculated from the Market Value of the IPO. The results of the investigation are displayed in the brackets

*** Total Direct Costs consist of Underwriter-Spread and Other Expenses, such as costs for Road Shows, expenses for printing of information material, etc.

In table 4.2 the univariate summary statistics for costs of going public are presented for both Market Segments under consideration, i.e., 1st Market Segment and Neuer Markt Segment. Unfortunately, no data for "Other Expenses" were available. Only very few companies present their costs of going public in their annual report of the considered year. Out of all 252 IPOs under consideration only 3 presented their respective costs. Others included these costs in accumulated expense items in their profit and loss accounts. The values in parentheses displayed in Other Expenses are the results of the deterministic costs, viz., listing fees which can easily be calculated as a percentage from the Market Value. It is obvious that the Underwriter-Spread in the Neuer Market is significantly higher than in the 1st Market Segment. The summary statistics of Total Direct Costs must be the same as no data for Other Expenses is available. Underpricing is not significantly different from Market Segment to Market Segment, and, thus, consistent with the finding of Affleck-Graves et al. (1993), who find also no significant difference in Underpricing between a high and a low served market, i.e., between Nasdaq and NYSE. Finally, Total Issue Costs differ significantly in both Market Segments. This is in accordance to the findings of Corwin and Harris (2001) who state that the difference is mainly driven by the lower Underwriter-Spread in the less served market. Table 4.2 suggests that there is a remarkable difference in Total Issue Costs for IPOs qualifying for both Market Segments. Thus, IPOs should take these costs into consideration when choosing their optimal policy and strategy for going public. However, these results do not control for other factors influencing issue costs, i.e., further investigation must be conducted.

Next we test for the different cost components using OLS. Explanatory quantitative variables are the log of the Market Value and Underwriter Market Share, and qualitative variables are VBC (venture backed capital), DIL (dual international listings) and 1st Market Segment listing.

The resulting ANCOVA (analysis-of-covariance) model is:

$$Y_i = \beta_0 + \beta_1 \log MV_i + \beta_2 UWMS_i + \beta_3 VBC_i + \beta_4 DIL_i + \beta_5 1^{st}{}_i + u_i$$

Where the regressands Y_i are:

UWS = Underwriter-Spread, which is the percentage difference between the offer price and the price paid to the issuing firm

OE = Other Expenses, legal and auditing expenses, listing and registration fees, and Other Expenses paid for the event

TDC = Total Direct Costs simply sums Underwriter-Spread and Other Expenses

UP = Underpricing = (first day closing price - offer price)/offer price

TIC = Total Issue Costs are Total Direct Costs and Underpricing

All costs are stated as a percentage of the Market Value.

The regressors are:

LnMV = Log of Market Value, offered shares multiplied by offer price, excluding Greenshoe

UWMS = Underwriter Market Share, the proportion of all IPO proceeds where a particular underwriter served as lead underwriter

VBC = Venture Backed Capital, a dummy variable which = 1 if another firm holds at least 17 % of the initial equity capital, zero otherwise

DIL = Dual International Listing, a dummy, if listed internationally = 1, 0 otherwise

1^{st} = First Segment Listing, a dummy, where 1 = listed on 1^{st} Market Segment, 0 = otherwise

To compare issue costs across the different Market Segments under consideration, we focus on a dummy variable of the Market Segment, being 1 if listed on the 1^{st} Market Segment, 0 otherwise, i.e., listed on the Neuer Markt Segment. Moreover, to test for different qualitative issues of IPOs, such as it matters whether IPOs are backed by venture capital, or, if they are already listed on an international stock exchange. Thus, we include further qualitative variables, VBC being 1 if backed by venture capital (at least 17 %) or DIL for being listed internationally, 0 otherwise, respectively.

Table 4.3: Results of OLS-ANCOVA Regression Analysis (General to Specific Approach)⊗

4.3.1 Panel A: Issue Costs = Underwriter-Spread (UWS)

UWS → **Regressors ↓**	**Specification 1**	**Specification 2**	**Specification 3**	**Specification 4**	**Specification 5**
Intercept	.20404 [2.1692] {.094064} (.925)	.24917 [2.1282] {.11708} (.907)	.18215 [2.1224] {.85825} (.932)	-1.5858 [.10509] {-15.0907} (.000)	-1.6115 [.10373] {-15.5354} (.000)
LnMV	-.10491 [.12343] {-.84999} (.396)	-.10731 [.12137] {-.88418} (.377)	-.10065 [.12068] {-.83404} (.405)	-	-
UWMS	-.0069958 [.061601] {-.11357} (.910)	-	-	-	-
VBC (Yes=1, No=0)	.12538 [.21219] {.59088} (.555)	.12488 [.21172] {.58982} (.556)	-	-	-
DIL (Yes=1, No=0)	-.77852 [.55618] {-1.3997} (.163)	-.77858 [.55507] {-1.4027} (.162)	-.79820 [.55381] {-1.4315} (.154)	-.78749 [.55343] {-1.4229} (.156)	-
1st Segment **(1 = 1st, 0 = NM)**	-1.2541 [.73592] {-1.7041} (.090)	-1.2524 [.73428] {-1.7056} (.089)	-1.2112 [.73000] {-1.6592} (.098)	-1.4450 [.67365] {-2.1450} (.033)	-1.5505 [.67093] {-2.3110} (.022)
N	252	252	252	252	252
R^2	.03372	.033021	.031653	.028926	.020998
Adj. R^2	.013339	.017298	.019892	.021095	.017066
F-statistic	(.141)	(.081)	(.047)	(.026)	(.022)
Diagnostic Tests					
Funct. Form	(.542)	(.568)	(.482)	(.355)	(1.00)
Normality	(.375)	(.355)	(.308)	(.319)	(.313)
Heteroscedasticity	(.174)	(.173)	(.238)	(.249)	(.167)

Values in parentheses are [standard errors], {t-values}and (p-values)

⊗ For panels A,B, and C the general to specific approach is conducted by omitting after each regression another independent variables which is statistically not significant

In specification 1 and 2 the p-value of the F-statistic is greater 5 %, not rejecting the null-hypothesis of all coefficients being jointly equal to zero and the partial coefficients are statistically insignificant. Through specifications 3 to 5 we can reject the null hypothesis at the 5%, the 3 %, and the 2.2 % level, respectively. R^2 and adjusted R^2 are, for cross-sectional data, at sufficient levels. The null hypotheses of correctly specified models, normally distributed disturbances, and homoscedasticity are not rejected through all specifications.

In an ANCOVA-model the intercept is of much interest. However, Intercepts in specifications 1 through 3 are highly insignificant. In specifications 4 and 5, they are highly significant but negative. This might be due to the fact that the variable Market Value was dropped and costs are stated as a percentage of the Market Value. Hence, we should not interpret negativity of the intercepts as subsidies being paid by any authority.

In specification 3, increasing Market Value by 1 % decreases the Underwriter-Spread by 0.1 %, other things being equal. This is consistent with economies of scale and equals the finding of Corwin and Harris (2001). Being dually internationally listed, the Underwriter-Spread drops by 0.8 % than otherwise, keeping all other factors constant. Finally, being listed in the 1st Market Segment, the Underwriter-Spread is 1.2 % lower than if listed on the Neuer Markt Segment, other things remaining constant. This is consistent with economic theory, where highly served markets have higher Underwriter-Spreads.

In specification 4, if an IPO is dually internationally listed, this will decrease the Underwriter-Spread by 0.8 %, ceteris paribus, and an IPO being listed on the 1st Market Segment, leads to a drop of the Underwriter-Spread of 1.4 %, other things equal. Both results are consistent with economic theory of different quality served markets.

Finally, in specification 5, an IPO being listed on the 1st Market Segment, leads to a drop of the Underwriter-Spread of 1.6 %, ceteris paribus, which again supports economic theory of higher Underwriter-Spreads in higher served markets. Other Expenses were not available. The regressions if deterministic listing fees are included into the analysis are displayed in annexe 1. All diagnostic tests are suggesting, to reject the null-hypotheses of a correctly specified model, normally distributed disturbances, and homoscedasticity. Next, we test for the cost component Underpricing:

4.3.2 Panel B: Issue Costs = Underpricing (UP)

UP → Regressors ↓	**Specifica- tion 1**	**Specifica- tion 2**	**Specifica- tion 3**	***White****	**Specifica- tion 4**	***White****	**Specifica- tion 5**	***White****
Intercept	.40291 [.74957] {.53752} (.591)	.32230 [.73590] {.4379} (.662)	.28800 [.73450] {.39211} (.695)	*.28800* *[.81486]* *{.35344}* *(.724)*	.30035 [.73392] {.40924} (.683)	*.30035* *[.81376]* *{.36909}* *(.712)*	.55274 [.67940] {.81358} (.417)	*.55274* *[.75481]* *{.73230}* *(.465)*
LnMV	.14719 [.042650 {3.4511] (.001)	.15147 [.041966] {3.6093} (.000)	.15488 [.041764] {3.7084} (.000)	*.15488* *[.045936]* *{3.3716}* *(.001)*	.15447 [.041737] {3.7012} (.000)	*.15447* *[.045890]* *{3.3662}* *(.001)*	.13984 [.038509] {3.6314} (.000)	*.13984* *[.042425]* *{3.2962}* *(.001)*
UWMS	.012496 [.021286] {.58707} (.558)	-	-	-	-	-	-	-
VBC (Yes=1, No=0)	.063020 [.073323] {.85948} (.391)	.063917 [.073209] {.87307} (.383)	-	-	-	-	-	-
DIL (Yes=1, No=0)	.16826 [.19219] {.87549} (.382)	.16837 [.19193] {.87722} (.381)	.16109 [.19166] {.84048} (.401)	*.16109* *[.18968]* *{.84925}* *(.397)*	-	-	-	-
1st Segment (1 = 1st, 0 = NM)	-.26919 [.24430] {-1.0586} (.291)	-.27231 [.25390] {-1.0725} (.285)	-.25126 [.25263] {-.99458} (.321)	*-.25126* *[.20584]* *{-1.2207}* *(.223)*	-.22874 [.25106] {-.91111} (.363)	*-.22874* *[.19673]* *{-1.1672}* *(.246)*	-	-
N	252	252	252	*252*	252	*252*	252	*252*
R^2	.060400	.059079	.056163	-	.053464	-	.050205	-
Adj. R^2	.041225	.043779	.044699	-	.045830	-	.046481	-
F-statistic	(.009)	(.005)	(.003)	-	(.001)	-	(.000)	-
<u>Diagnostic Tests</u>								
Funct. Form	(.423)	(.350)	(.360)	-	(.431)	-	(.317)	-
Normality	(.611)	(.611)	(.649)	-	(.656)	-	(.641)	-
Heterosced.	(.055)	(.060)	(.032)	-	(.026)	-	(.029)	-

Values in parentheses are [standard errors], {t-values}and (p-values)

* White columns in all tables and panels list heteroscedasticity consistent estimates of the variance-covariance matrices

The null hypothesis of all coefficients being jointly equal to zero can be rejected in specifications 1 through 5. Almost all diagnostic tests are at acceptable high levels, only specifications 3 through 5 seem to suffer from the heteroscedasticity problem but the "White columns" beside the initial columns show the consistent estimates of the variance-covariance matrices. However, p-values of the estimators do not change much. R^2 and adjusted R^2 are at acceptable cross-sectional levels. Through all specifications, only the variable Market Value appears to be statistically significant while the intercepts are highly insignificant. Nevertheless, Underpricing represents 0.4 % in specification 1, 0.3 % in specifications 2 to 4, and 0.6 % in specification 5 of the Market Value, respectively.

If the Market Value goes up by 1 %, Underpricing increases by 0.15 % in specifications 1 through 4, and 0.14 % in specification 5, all other things remaining the same. In specification 1, increasing the underwriter market share by 1 % decreases the Underpricing by 0.01 %, ceteris paribus, meaning that a higher Underpricing variable is due to a higher quality underwriter. In specification 1 and 2, Venture Backed Capital is positively related to Underpricing, which is in sharp contrast to the findings of Megginson and Weiss (1991), who report a negative relation between Venture Backed Capital and Underpricing. If another company holds at least 17 % of the equity capital, i.e., being backed by Venture Capital, Underpricing rises by 0.06 %, other things remaining the same. Being internationally dually listed in specifications 1, 2, and 3, leads to an increase in Underpricing of 0.17 %, 0.17%, and 0.16 %, respectively, ceteris paribus. Finally, an IPO being listed on the 1st Market Segment in specification 1 through 4 decreases Underpricing by 0.27 % in specification 1 and 2, in specification 3 by 0.25 %, and, finally in specification 4 by 0.23 %, respectively, other things remaining the same.

Finally, we test for the summary cost component Total Issue Costs:

4.3.3 Panel C: Issue Costs = Total Issue Costs (TIC = UWS + UP)

TIC → **Regressors ↓**	**Specification 1**	**Specification 2**	**Specification 3**	***White****	**Specification 4**	***White****	**Specification 5**	***White****
Intercept	.50791 [.73661] {.68999} (.491)	.42402 [.72276] {.58667} (.558)	.43417 [.72211] {.60125} (.548)	*.43417* *[.80023]* *{.54255}* *(.588)*	.40133 [.72062] {.55693} (.578)	*.40133* *[.80223]* *{.50027}* *(.617)*	.66835 [.66726] {1.0016} (.317)	*.66835* *[.74474]* *{.89743}* *(.370)*
LnMV	.14273 [.041885] {3.4077] (.001)	.14719 [.041217] {3.5711} (.000)	.14694 [.041185] {3.5679} (.000)	*.14694* *[.04490]* *{3.2720}* *(.001)*	.15017 [.040980] {3.6645} (.000)	*.15017* *[.045243]* *{3.3192}* *(.001)*	.13469 [.037821] {3.5612} (.000)	*.13469* *[.041865]* *{3.2172}* *(.001)*
UWMS	.013006 [.020904] {.62217} (.534)	-	-	-	-	-	-	-
VBC (Yes=1, No=0)	.061759 [.072007] {.85768} (.392)	.062693 [.071902] {.87193} (.384)	.060205 [.071780] {.83874} (.402)	*.060205* *[.070521]* *{.85372}* *(.394)*	-	-	-	-
DIL (Yes=1, No=0)	.14998 [.18874] {.79446} (.428)	.15010 [.18850] {.79624} (.427)	-	-	-	-	-	-
1st Segment (1 = 1st, 0 = NM)	-.27938 [.24973] {-1.1187} (.264)	-.28262 [.24937] {-1.1334} (.258)	-.26086 [.24768] {-1.0532} (.293)	*-.26086* *[.19914]* *{-1.3099}* *(.191)*	-.24199 [.24651] {-.98168} (.327)	*-.24199* *[.19600]* *{-1.2346}* *(.218)*	-	-
N	252	252	252	*252*	252	*252*	252	*252*
R^2	.058756	.057269	.054839	-	.052147	-	.048464	-
Adj. R^2	.039547	.041940	.043359	-	.044503	-	.044643	-
F-statistic	(.011)	(.006)	(.003)	-	(.001)	-	(.000)	-
Diagnostic Tests								
Funct. Form	(.450)	(.355)	(.454)	-	(.419)	-	(.302)	-
Normality	(.779)	(.784)	(.804)	-	(.814)	-	(.792)	-
Heterosced.	(.049)	(.053)	(.039)	-	(.024)	-	(.027)	-

Values in parentheses are [standard errors], {t-values}and (p-values)
* White columns in all tables and panels list heteroscedasticity consistent estimates of the variance-covariance matrices

Diagnostic tests through all specifications are at sufficiently high levels, only specifications 3 through 5 suffer from slight heteroscedasticity. The "White columns" show the consistent estimates of the variance-covariance matrix of the parameter estimates. P-values of these estimates do not differ much and inference will not change. The null hypotheses of all coefficients being jointly equal to zero can be rejected through all specifications. Also R^2 and adjusted R^2 are with 5 % and 4 % levels in all specifications at for cross-sectional data acceptable levels. F-statistics are significant through all specifications, saying that the null hypotheses of all variables being jointly equal to zero can be rejected at sufficiently high levels. Intercepts through all specifications are highly statistically insignificant. Nevertheless, Total Issue Costs represent 0.5 % in specification 1, 0.4 % in specifications 2 to 4, and 0.7 % in specification 5, of the Market Value, respectively, other things remaining the same.

In specification 1 through 5, all coefficients of the Market Value are highly statistically significant. Increasing the Market Value by 1 % increases the Total Issue Costs of the IPOs by about 0.15 % through all specifications, keeping all remaining things constant. This is again different to the finding of Corwin and Harris (2001), who find that Total Issue Costs are negatively related to offer proceeds, which is consistent with economies of scale.

In specification 1, rising the Underwriter Market Share is positively related to Total Issue Costs, which is consistent with Beatty and Welch (1996), who find a positive relation between Underwriter Market Share and Total Issue costs, but Corwin and Harris (2001) find a negative relation between both variables. Increasing Underwriter Market Share by 1 % will increase Total Issue Costs by 0.013 %, ceteris paribus, saying that if higher costs are charged, IPOs would also employ higher quality underwriters in order to ensure return on investment. Specifications 1 through 3, if other companies hold at least 17 % of the IPO's equity capital, Total Issue Costs are higher by 0.06 %, other things constant. That means that an IPO being backed by venture capital does affect Total Issue Costs only marginally.

In specification 1 and 2, if IPOs are internationally dually listed, Total Issue Costs are by 0.15 % higher than otherwise, ceteris paribus, confirming our previous research, were we found that more internationally dually listed IPOs go public in the Neuer Markt. IPOs being listed on the 1st Market Segment in specifications 1 through 4, decreases Total Issue Costs by 0.28 %, 0.28 %, 0.26 %, and 0.24 %, respectively, keeping all other things constant. This is consistent with the finding of Corwin and Harris (2001), were Total Direct Issue Costs are also negatively related to the dummy of IPOs being listed on the NYSE.

For all three investigated issue costs the dummy variable for the 1st Market Segment were not significant, except for the investigation of the Underwriter-Spread in specification 4 and 5 of table 4.3, panel A. This is different to the reported values of Corwin and Harris (2001) who found that the dummy on NYSE listings are highly significant for Underwriter-Spread, Other Expenses, and Total Direct Costs, which is simply the sum of Underwriter-Spread and Other Expenses. Again, this difference might be due to the fact that no data on Other Expenses was available.

Hence, we check whether issue costs matter for all data available through the whole period from March 1997 to December 2001, viz. 362 observations. As there will be an additional Market Segment, i.e., SMAX[38], another independent dummy variable will be included in the investigation:

NM = Neuer Markt, 1 if listed on Neuer Markt, 0 otherwise

That means, that if both included dummies of IPOs listed on the 1st Market Segment or on the Neuer Markt Segment are negative, this will contribute to the SMAX Segment.

As a next step, we analyse whether the issue cost statistics deviate if all IPOs are included from the one where only IPOs are included that fulfil listing requirements for the 1st Market Segment and the Neuer Markt Segment.

[38] There exist 350 German small caps which make less than 10 % of the trading volume of the Frankfurt Stock exchange. "In order to provide these companies with an attractive platform, Deutsche Boerse AG is creating the quality segment SMAX. SMAX is targeting small caps that actively promote investor relations and react quickly and efficiently to changes on the capital market." See Deutsche Boerse SMAX Small Caps - High Standards, January 1999, p. 4 and http://www.smax.de

Table 4.4 : Issue Costs Statistic for all 362 IPOs from March 1997 to December 2001

Variable in %	1st Segment	Neuer Markt	SMAX	All IPOs	p-values*
N	9	314	41	362	-
Underwriter-Spread	4.68 %	14.20 %	7.02 %	13.23 %	(.028)
Other Expenses**	n.a. [0.6 %]	n.a. [2.36 %]	n.a. [4.38 %]	n.a. [2.56 %]	- [.000]
Total Direct Costs***	4.68 % [5.28 %]	14.20 % [16.56 %]	7.02 % [11.4 %]	13.23 % [15.79]	- (.000)
Underpricing	0.14 %	0.48 %	0.24 %	0.45 %	(.081)
Total Issue Costs	**4.82 %** **[5.42 %]**	**14.68 %** **[17.04 %]**	**7.26 %** **[11.64 %]**	**13.68 %** **[16.24 %]**	**(.031)** **[.021]**

Values in [ ] parenthesis show the results if deterministic listing fees (see annexe 1) as a percentage of the Market Value of the respective IPO are included in the investigation

* The Kolmogorov-Smirnov-test showed for all investigated data sets that exhibited p-values < 0.05, i.e., the populations of the investigated Market Segments are unlikely to be Gaussian. Then, a Kruskal-Wallis-test has been conducted with the software package "GraphPad Instad Version 3.00". We can accept the null-hypothesis of equal medians for the investigated Market Segments for Underpricing only. However, for Underwriter-Spread and Total Issue Costs we do reject the null-hypotheses of equal medians, saying that data sets are drawn from different medians. In other words, variables differ much in the investigated 3 Market Segments, which was expected as IPOs were included that did not fulfil requirements for the 1st Market Segment and for Neuer Markt Segment, or both.

** Data on Other Expenses was not available = n.a., hence, Underwriter-Spread = Total Direct Costs. The deterministic part, i.e., the listing fees can easily be derived from the fees schedules displayed in annexe 1.

*** Total Direct Costs consist of Underwriter-Spread and Other Expenses, such as costs for Road Shows, expenses for printing of information material, etc.

Table 4.4 presents the univariate summary statistics for costs of going public when all IPOs in the investigated period are taken into consideration. As in table 4.2, no data for Other Expenses was available. However, Underwriter-Spread is highest in the Neuer Markt, followed by the SMAX Segment, and finally lowest in the 1st Market Segment, which is in accordance with economic theory. When taking all IPOs into consideration, Underpricing differs much in the investigated Market Segments. Again, the highest value is in the Neuer Markt Segment, followed by the SMAX Segment, and last but not least the 1st Market Segment. Total Issue Costs differ much when all IPOs are taken into consideration. This is in accordance with economic theory and suggests that IPOs should take issue costs in consideration. However, further investigation will be conducted to check for other influences into the cost of going public. Table 4.5 below lists all values of the investigated issue costs, viz. Underwriter-Spread, Underpricing and Total Issue Costs as defined in Panel A, B, and C of Table 4.3. Results if deterministic listing fees of Other Expenses are included into the investigation are displayed in annexe 1, but are no subject to further investigation.

Table 4.5: Results of OLS-ANCOVA Regression Analysis for all 362 IPOs

Issue Costs→ **Regressors ↓**	**Underwriter-Spread**	***White****	**Underpricing**	**Total Issue Costs**
Intercept	-1.7224 [1.5760] {-1.0920} (.275)	*-1.7224* *[1.6829]* *{-1.0235}* *(.307)*	-1.3313 [2.0692] {-.64340} (.520)	-3.7589 [3.2652] {-1.1512} (.250)
LnMV	.12367 [.090351] {1.3688] (.172)	*.12367* *[.09319]* *{1.3267]* *(.185)*	-.056549 [.11863] {-.47669] (.634)	.14081 [.18720] {.75219] (.452)
UWMS	.12515 [.22457] {.55728} (.578)	*.12515* *[.23201]* *{.53940}* *(.590)*	.0082940 [.29485] {.028130} (.978)	-.0089611 [.46527] {-.019260} (.985)
VBC (Yes=1, No=0)	-.045544 [.17805] {-.25580} (.798)	*-.045544* *[.179886]* *{-.25322}* *(.800)*	.29003 [.23377] {1.2406} (.216)	.23744 [.36889] {.64366} (.520)
DIL (Yes=1, No=0)	.36050 [.25344] {1.4224} (.156)	*.36050* *[.24097]* *{1.4960}* *(.136)*	.29196 [.33276] {.87739} (.381)	.29841 [.52510] {.56830} (.570)
1st Segment **(1 = 1st, 0 = otherwise)**	-.62659 [.70093] {-.89394} (.372)	*-.62659* *[.56616]* *{-1.1067}* *(.269)*	-.87945 [.92030] {-.95561} (.340)	-2.1810 [1.4522] {-1.5018} (.134)
Neuer Markt Segment **(1 = NM, 0 = otherwise)**	1.0817 [.28237] {3.8309} (.000)	*1.0817* *[.31544]* *{3.4293}* *(.001)*	.95433 [.37075] {2.5741} (.010)	1.8273 [.58504] {3.1234} (.002)
N	362	*362*	362	362
R^2	.063287	-	.036117	.050353
Adj. R^2	.047411	-	.019780	.034257
F-statistic	(.001)	-	(.042)	(.005)
<u>Diagnostic Tests</u>				
Functional Form	(.949)	-	(.711)	(.968)
Normality	(.293)	-	(.036)	(.065)
Heteroscedasticity	(.026)	-	(.216)	(.616)

Values in parentheses are [standard errors], {t-values}and (p-values)
* White columns in all tables and panels list heteroscedasticity consistent estimates of the variance-covariance matrices

Diagnostic tests through all investigated issue costs regressions are at sufficiently high levels, only in the regression where the Underwriter-Spread is estimated, the equation suffers slightly from heteroscedasticity, but the "White column" beside shows consistent estimates of the variance co-variance matrices of the parameter estimates. R^2 and adjusted R^2 are comparable to the values found in the above investigations, with quite low, but for cross-sectional data still acceptable values. The null hypotheses of all coefficients being jointly equal to zero, the F-test, can be rejected in all investigated cases at the minimum 5 % level. All partial coefficients are highly statistically insignificant, only the dummy of IPOs being listed on the Neuer Markt Segment appears to be highly statistically significant in all cases, saying that only Issue Costs in the Neuer Market Segment matter. In other words, IPOs going public in the other two Market Segments will not take care about these Issue Costs. All intercepts are negative which can be derived from the fact that data sets were drawn from different populations (see table 4.4, results of the non-parametric Kruskal-Wallis-test) and which gives evidence that a subsidy was paid (either by the Frankfurt Stock Exchange, or by any authority), but no further information on such subsidies was available. Negativity could also be due to missing data on Other Expenses. Due to this uncertainty, we do not interpret the intercepts.

Specification 1, where the cost component is Underwriter-Spread shows slight heteroscedasticity, but is being corrected and values are displayed in the "White column". By raising the Market Value by 1 %, the Underwriter-Spread increases by 0.12 %, other things being equal. This is different to the finding of Corwin and Harris (2001) where offer proceeds are negatively related to Underwriter-Spread. While US-data is highly significant for the Market Value, the German data is insignificant concerning the same variable. This might be due to the more extensive US-data set. Next variable being estimated is underwriter market share which is for German and for US-data insignificant and positively related to this kind of Issue Costs. Increasing underwriter market share by 1 % increases the Underwriter-Spread by 0.13 %, ceteris paribus, which means that IPOs being faced by a higher Underwriter-Spread also want higher quality underwriters. This is also significantly higher than in the US-market were comparable estimates increase by only 0.004 %, other things constant (see Corwin and

Harris [2001], p. 52). Venture backed capital is negatively related to the Underwriter-Spread which is different to US-data, where data is positively related to Underwriter-Spread. If an IPO is backed by venture capital, the Underwriter-Spread decreases by 0.5 %, ceteris paribus, and an IPO being internationally dually listed, the Underwriter-Spread increases by 0.05 %, other things being the same. The dummy variable of an IPO being listed on the 1st Market Segment is negatively related to the Underwriter-Spread and it decreases by 0.63 % when the IPO is listed on the 1st Market Segment, other things remaining the same. The dummy variable on listings on the Neuer Markt Segment are highly significant. An IPO being listed on the Neuer Markt Segment, the Underwriter-Spread is by 1.08 % higher than otherwise, other things remaining the same.

In specification 2, increasing Market Value and Underwriter Market Share by 1 %, this decreases Underpricing by 0.06 %, and increases it by 0.008 %, respectively, ceteris paribus. An IPO being internationally dually listed, and being backed by venture capital increases Underpricing by 0.3 %, respectively, ceteris paribus. The dummies on listings on the 1st Market Segment and on the Neuer Markt Segment show that if being listed in the respective Market Segment, Underpricing decreases by 0.88 % and increases by 0.95 %, respectively, the rest remaining unchanged, which is consistent with the economic theory of the highly served market hypothesis.

Finally, the regression of the cost component Total Issue Costs is estimated. Surprisingly Market Value is positively related to Total Issue Costs, which is not consistent with economies of scale, and different to the finding of Corwin and Harris (2001). This might be explained by the fact that no data was available on Other Expenses, hence, Total Issue Costs represent the sum of Underwriter-Spread and Underpricing. Increasing the Market Value and Underwriter Market Spread by 1 % increases Total Issue Costs by 0.14 %, and decreases it by 0.009 %, respectively, other things remaining the same. The dummies on VBC and DIL are positively related with Total Issue Costs and increase them by 0.24 % and 0.3 %, respectively, the rest remaining unchanged. The listing dummies do not change behaviour. An IPO being listed on the 1st Market Segment or on the Neuer Markt Segment, decreases Total Issue Costs by 2.18 %, and raises them by 1.83 %, respectively, ceteris paribus. These predicted reactions of IPOs are in accordance with the finding of Corwin and Harris

(2001), p. 52, where the dummy on listings on the NYSE is negatively related to Total Issue Costs.

The differences to the findings of Corwin and Harris (2001), where comparable dummy variables of the whole investigation, such as reverse LBOs and Carveouts are partially significant, can probably be explained firstly by the smaller sample size (438 to 252), secondly by the smaller market size (\$m 27,312 ≈ Euro mil 30,722 from 1991 to 1996 to Euro mil 25,242 from March 1997 to December 2001), and finally by the less developed German Financial Market (while Nasdaq exists for more than 20 years, Neuer Markt Segment was founded in March 1997).

Moreover, we find no evidence to support the prediction of Foucault and Parlour (2001) who develop a model where two exchanges compete on the basis of listing fees and trading costs. However, as the 1st Market Segment and the Neuer Markt Segment (and of course the SMAX) are run by the Frankfurt Stock Exchange it is very unlikely that there exists real competition. Investigations give evidence to the conjecture that the Frankfurt Stock Exchange directs IPOs to the Neuer Markt Segment. Only very few and well known companies go straight to the 1st Market Segment as they are considered not need market maker sponsorship, i.e., liquidity support by binding bid and ask limits for the sponsored shares.

4.4 Conclusion

This paper documents the differences in the types of firms making a choice of going public in Germany. It is shown that Total Issue Costs do not differ across Market Segments. However, the Underwriter-Spread is significantly higher on the Neuer Markt Segment than on the 1st Market Segment. Using a non-parametric test for IPOs that fulfil requirements for 1st Market Segment and Neuer Markt (the so-called Wilcoxon-rank test) for Underwriter-Spread, Underpricing and Total Issue Costs, we do not reject the null-hypothesis of equal medians of data sets in both Market Segments, meaning that variables do not differ much in these Market Segments. In other words, they are likely to be drawn from the same population. No data was available for Other Expenses but Corwin and Harris (2001) state that Listing and Registration Fees are deterministic and a major part of Other Expenses. By excluding them, their investigation did not change significantly. Hence, we conclude that the omission of Other Expenses does not influence our estimation and its results significantly.

Upon finding that the dummy variable on 1st Market Segment Listing was not significant through almost all investigated cases (except for the case of excluding the variable Market Value in Panel A of table 4.3), we tested data for all 362 observations available in the investigated period form March 1997 to December 2001. Using a non-parametric test again (the so-called Kruskal-Wallis-test), we found that data sets are unlikely to be drawn from the same population, which is consistent with our previous research where it was found, that not all IPOs fulfil requirements for 1st Market Segment and Neuer Markt Segment.

In Germany, shares of the 1st Market Segment (equivalent of NYSE) and the Neuer Market Segment (which was modelled on Nasdaq) can be traded on either the German electronic trading platform Xetra, which is an order driven system with automatic matching technologies that anonymously combines activities of institutional investors and personal banking in one central order book, or per "open outcry" at the trading floor. This is in sharp contrast with the theory of the choice of different trading technology in order to relax competition modelled by Foucault and Parlour (2001) which they consider as being a source of vertical differentiation of trades. No evidence was found that supports their model of competing exchanges, which was explained by the fact that the German major Segments are not really competing. However, another source of vertical differentiation is that stocks traded on one stock exchange will not be traded on another one, which is the case in Germany. For example, Regional Stock Exchanges trade shares that cannot be traded on the Frankfurt Stock Exchange and vice versa.

When a firm goes public in Germany, the Frankfurt Stock Exchange will guide it into the Neuer Markt Segment, or into the SMAX segment, due to the designated sponsorship which acts as a liquidity support unless its size and knowledge of existence to the public is sufficiently high in order to allow them to enter the 1st Market Segment straight away.

Annexe 1:

4.6 Results of Regressions including Deterministic Costs (ANCOVA)

Issue Costs→ Regressors ↓	Other Expenses	Total Direct Costs	Total Issue Costs	Other Expenses	Total Direct Costs	Total Issue Costs
N	**252**	**252**	**252**	**362**	**362**	**362**
Intercept	.35566 [.017268] {20.5962} (.000)	1.7366 [.93180] {1.8637} (.064)	2.1395 [1.2879] {1.6612} (.098)	.36190 [.015572] {23.2407} (.000)	-2.0657 [1.8085] {-1.1422} (.254)	-3.3970 [3.2659] {-1.0401} (.299)
LnMV	-.018850 [.9826E-3] {-19.1843] (.000)	-.067799 [.053019] {-1.22788] (.202)	.079390 [.073284] {1.0833] (.280)	-.018356 [.8927E-3] {-20.5612] (.000)	.17900 [.10368] {1.7265] (.085)	.12245 [.18723] {.65400] (.514)
UWMS	-.6284E-3 [.4904E-3] {-1.2815} (.201)	.037471 [.026461] {1.4161} (.158)	.049968 [.036575] {1.3662} (.173)	-.0019531 [.0022189] {-.88023} (.379)	-.019208 [.25769] {-.074539} (.941)	-.010914 [.46536] {-.023453} (.981)
VBC (Yes=1, No=0)	-.0020364 [.0016892] {-1.2055} (.229)	.012278 [.091149] {.13470} (.893)	.075298 [.12599] {.59766} (.551)	-.0030255 [.0017593] {-1.7197} (.086)	-.055613 [.20431] {-.27219} (.786)	.23441 [.36897] {.63533} (.526)
DIL (Yes=1, No=0)	-.0036814 [.0044276] {-.83146} (.407)	-.30273 [.23891] {-1.2671} (.206)	-.13466 [.33023] {-.40719} (.684)	.0046321 [.0025042] {1.18497} (.065)	.011083 [.29083] {.038108} (.970)	.30305 [.52521] {.57700} (.564)
1st Segment (1 = 1st, 0 = otherwise)	.025895 [.0058584] {4.4201} (.000)	-.30060 [.31612] {-.95091} (.343)	-.56980 [.43695] {-1.3040} (.193)	.016911 [.0069258] {2.4418} (.015)	-1.2846 [.80434] {-1.5971} (.111)	-2.1641 [1.4525] {-1.4899} (.137)
Neuer Markt Segment (1 = NM, 0 = otherwise)	-	-	-	-.015028 [.0027901] {-5.3862} (.000)	.85797 [.32403] {2.6478} (.008)	1.8123 [.58516] {3.0971} (.002)
R^2	.62738	.02913	.020622	.59476	.046647	.049580
Adj. R^2	.61978	.0094011	.6349E-3	.58789	.030489	.033472
F-statistic	(.000)	(.199)	(.399)	(.000)	(.009)	(.006)
Diagnostic Tests						
Funct. Form	(.000)	(.625)	(.397)	(.000)	(.718)	(.929)
Normality	(.000)	(.000)	(.000)	(.000)	(.000)	(.067)
Heteroscedast.	(.000)	(.054)	(.386)	(.000)	(.130)	(.561)

Chapter five: Conclusion

I argue in this thesis that the German Financial Market is rather underdeveloped compared to the Financial Market in the United States. Evidence of this argument is given by the fact that the Neuer Markt segment was launched in March 1997 and modelled on Nasdaq while Nasdaq itself exists for more than 20 years. While the Financial Market in the US is extensively and permanently explored, the Financial Market in Germany is almost barely investigated. This thesis raises some questions, which have partially been discussed in the US, but not in Germany. Moreover, one chapter deals with the application of Industrial Organisation Theory to the securities industry, and this is even in the advanced Financial Market in the US hardly explored. Latest research in the United States of America suggest further research to be conducted in the German Financial Market and will be discussed in section 5.1. Given the abundance of empirical research with data of the German Financial Market concerned with competition behaviour and decisions of IPOs which of the available market segments to join, I point out the importance of German particularities to be taken into consideration when researching empirically the Financial Market in Germany. The thesis consists of three self-contained essays and each essay includes a section where the specific literature is being surveyed.

Chapter two sets out to investigate which competition behaviour serves the German Financial Market most. Using a model in which sequential decision taking is investigated and taking account of the randomness of costs of the providers of the different market places, the model provides a solution where sequential decision are in favour of the market participants. Then, this model is estimated by data of the German Financial Market. This chapter makes a clear contribution to the existing literature by providing answers based on empirical research. The main weakness of this chapter is that data is not optimal and so-called "proxies" have been used to approach the problem. 60 monthly observations do not seem to be a huge data set, but it covers the period after the launch of the Neuer Markt segment to present, missing only 10 observations. However, it provides a sound grasp of the competition in the German Financial Market.

Chapter three investigates factors influencing listing decisions of German IPOs when going public, different to cost considerations, while chapter four examines different cost components in the public going process. Both chapters contribute to the existing literature by examining the decisions of IPOs empirically and by identifying qualitative variables which are specific to German circumstances. Data available covers the whole period of the launch to the collapse of the international financial markets due to the economic cycle but also heavily and negatively influenced by the September 11th attacks against the United States of America. In total, 362 observations were available but only 261 IPOs fulfilled the requirements for both investigated market segments, and 9 of them went bankrupt meanwhile so 252 IPOs have been investigated. Finding in chapter four that the dummy on 1st Market segment IPOs is not significant, I investigated the cost components of all IPOs available. There is a clear need of further research after the recovery of the global economy in order to robustify the results. The major weakness of chapter three is that clear follow-on strategies do not exist in the German Financial Market so far and stock reserves have been used as a proxy. Chapter four's main weakness is the fact that no data on other expenses was available. Hence, the whole investigation misses an important aspect of IPOs' characteristics.

5.1 Suggestions for Further Research

A number of suggestions for further research of the German Financial Market arise when surveying the available literature of the United States of America. The most exciting characteristic of this thesis is that results obtained from empirically examining the German Financial Market can be compared to the results obtained by research of the US- Market and conclusions can be drawn as well as suggestions can be made. I am glad to have had the opportunity of looking at three different but related questions concerning the developing German Financial Market rather than concentrating on one only.

Chapter two by applying IO theory to the German Financial Market automatically suggests to further research the competition issue not only taking account of the quantity strategy space but also of the price strategy space when costs are taken into consideration. Furthermore, a combination of both strategy spaces and its empirical investigation might be an interesting topic to be explored in more depth. Nevertheless, the wide range of topics of IO theory leaves a great deal of room for further investigation.

Chapter three and four by investigating listing decisions of German IPOs which have been conducted for US-American IPOs suggest more research of the behaviour of IPOs or of circumstances influencing the behaviour of IPOs, such as the development of secondary liquidity (see Corwin, Harris, and Lipson [2002]), or the technical analysis and liquidity problems investigated by Kavajecz and Oders-White (2002), and many more. Hence, numerous opportunities for further research exist. The fact of the Financial Market in the US being outstandingly advanced compared to the German Financial Market provides a great opportunity of learning by comparing. After the rapid development of Germany's Financial Market, a reflection is needed of what happened in order to predict what could be the further development for some years to come.

5.2 Firm Policy Recommendations

Suggestions for any strategy of firm policy can be made but given the fact of the weaknesses of the research, such as the use of proxies rather than well-fit data leave the suggestions with a grain of salt.

Firstly, chapter two suggests that competition behaviour might be more beneficial for the participants of the German Financial Market when deciding sequentially instead of playing Nash, i.e., deciding simultaneously. Chapters three and four suggest that the Frankfurt Stock Exchange should try to build real "inhouse competition" instead of directing IPOs straight to the Neuer Markt segment. Due to the severe losses of the stock market indices, in particular the outstanding down-fall of the NEMAX50 and the inherent loss of reputation of that market segment, more IPOs should have the chance of issuing shares at the 1st Market segment. Of course, issuing financial statements, accounts and balance sheets not only according to the German Trade Code HGB but also according to US-GAAP and IAS in order to make it more visible for international investors and, thus, more attractive investing in German shares.

Taken together, this thesis suggests that firm policy makers should consider the likely costs and benefits of competition and going public decisions on a case by case basis, rather than just following the advise made by the Frankfurt Stock Exchange or by the pure wish deciding simultaneously (which is often regarded as deciding independently) when dealing with competition strategy issues.

Appendices

Appendix 1: Admission Fees

Regulations for the Frankfurt Stock Exchange, FWB12e-up3, January 4, 1999, page 9

Issue Amount in EURO	Fee in EURO
Up to 5 million	1,000
Up to 10 million	1,400
Up to 15 million	2,100
Up to 20 million	2,800
Up to 25 million	3,500
Up to 30 million	4,000
Up to 35 million	4,500
Up to 40 million	5,000
Up to 45 million	5,500
Up to 50 million	6,000
Up to 60 million	6,500
Up to 70 million	7,000
Up to 80 million	7,500
Up to 90 million	8,000
Up to 100 million	8,500
Up to 150 million	9,000
Up to 200 million	9,500
Up to 250 million	10,000
Up to 300 million	10,500
And for each additional amount of 50 million	+ 500

Rules and Regulations Neuer Markt

Part 4

Schedules of Fees

"An annual flat fee in the amount of EUR 7,500 shall be payable for the admission to and trading on the Neuer Markt. The fee shall not be refundable in the event that admission is terminated before the expiration of a calendar year." Rules and Regulations Neuer Markt, Deutsche Boerse Group Infoline, FWB09e, October 18, 2001, page 40

Conditions for Participation in SMAX

Fees: "An annual fee in the in the amount of EUR 7,500 shall be payable for the participation in SMAX." Deutsche Boerse Group Infoline, FWB 1e-up3, January 27, 1999, page 7

Appendix 2: List of References

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